Supporting information

Reusable Co-nanoparticles for general and selective N-alkylation of amines and ammonia with alcohols

Zhuang Ma,[a] Bei Zhou,[a] Xinmin Li, [a] Ravishankar G. Kadam, [b] Manoj B. Gawande,[b] Martin Petr,[b] Radek Zbořil,[b,c] Matthias Beller* [a] and Rajenahally V. Jagadeesh*[a]

[a] Leibniz-Institut für Katalyse e.V., Albert-Einstein-Str. 29a, Rostock, D-18059, Germany
[b] Regional Centre of Advanced Technologies and Materials, Czech Advanced Technology and Research Institute, Palacky University Olomouc, Šlechtitelů 27, 73 71, Olomouc, Czech Republic.
[c] CEET, Nanotechnology Centre, VŠB–Technical University of Ostrava, 17. Listopadu 2172/15, 70800 Ostrava-Poruba, Czech Republic.

*Corresponding authors
E-mails: matthias.beller@catalysis.de ; jagadeesh.rajenahally@catalysis.de

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S1. Materials and methods

Alcohols and amines were obtained commercially from various chemical companies. Cobalt(II) nitrate hexahydrate (cat no.139267-100G) and silica suspension (Silica LUDOX® AS-40 colloidal silica, cat no. 420840-1L) were purchased from Sigma Aldrich. 1,10-Phenanthroline monohydrate (cat no. P0879-25G), 2, 2'-bipyridine (cat no. B0468 -25G) and 2,2':6',2''-terpyridine (cat no. T0024 -1G) were purchased from TCI Chemicals. 2,6-Bis(2-benzimidazolyl)pyridine (cat no. 379433-1G) was purchased from Sigma Aldrich. The pyrolysis experiments were carried out in Dekema Austromat 624 oven. All catalytic experiments were carried out in ACS pressure tubes. Unless otherwise stated all reagents were used directly without purification.

XRD powder pattern were recorded on a Panalytical X'Pert diffractometer equipped with a Xcelerator detector using automatic divergence slits and Cu kα1/α2 radiation (40 kV, 40 mA; λ= 0.15406 nm, 0.154443 nm). Cu beta-radiation was excluded using a nickel filter foil. The measurements were performed in 0.0167° steps and 100 s of data collecting time per step. The samples were mounted on silicon zero background holders. The obtained intensities were converted from automatic to fixed divergence slits (0.25°) for further analysis. Peak positions and profile were fitted with Pseudo-Voigt function using the High Score Plus software package (Panalytical). Phase identification was done by using the PDF-2 database of the International Center of Diffraction Data (ICDD).

The low-resolution imaging of catalyst morphology was obtained with a transmission electron microscope (TEM) JEOL equipped with a LaB6 emission gun and operating at 160 kV. Microscopic TEM images were obtained by HRTEM TITAN 60-300 with X-FEG type emission gun, operating at 80 kV. This microscope is equipped with Cs image corrector and a STEM high-angle annular dark-field detector (HAADF). The point resolution is 0.06 nm in TEM mode. The elemental mappings were obtained by STEM-Energy Dispersive X-ray Spectroscopy (EDS) with acquisition time 20 min. For HRTEM analysis, the powder samples were dispersed in ethanol and 5 min ultrasonicated. One drop of this solution was placed on a copper grid with holey carbon film.

XPS surface investigation has been performed on the PHI 5000 Versa Probe II XPS system (Physical Electronics) with monochromatic Al-Kα source (15 kV, 50 W) and photon energy of 1486.7 eV. Dual beam charge compensation was used for all measurements. All the spectra were measured in the vacuum of 1.3 x 10^{-7} Pa and at the room temperature of 21 °C. The analyzed area on each

sample was spot of 200 μm in diameter. The survey spectra were measured with pass energy of 187.850 eV and electron volt step of 0.8 eV while for the high-resolution spectra was used pass energy of 23.500 eV and electron volt step of 0.2 eV. The spectra were evaluated with the MultiPak (Ulvac - PHI, Inc.) software. All binding energy (BE) values were referenced to the carbon peak C 1s at 284.80 eV.

GC and GC-MS analysis were recorded on Agilent 6890N instrument. GC conversion and yields were determined by GC-FID, HP6890 chromatograph with FID detector, column HP 530 m x 250 mm x 0.25 μm. NMR spectra are recorded using Bruker 300 Fourier, Bruker AV 300 and Bruker AV 400 spectrometers. Chemical shifts are reported in ppm relative to the deuterated solvent. Coupling constants are expressed in Hertz (Hz). The following abbreviations are used: s = singlet, bs = broad singlet d = doublet, t = triplet and m = multiple. The residual solvent signals were used as references for ^{1}H and ^{13}C NMR spectra ($CDCl_3$: δH = 7.26 ppm, δC = 77.12 ppm; DMSO-d_6: δH = 2.50 ppm, δC = 39.52 ppm). High resolution mass spectra (HRMS) were obtained either from a MAT 95 XP from Thermo (EI) or from an HPLC system 1200 and downstream ESI-TOF-MS 6210 from Agilent (ESI).

S2 Procedure for the preparation of catalysts

In a 100 mL dried round bottomed flask, 291.03 mg $Co(NO_3)_2 \cdot 6H_2O$ (1 mmol) and 543.09 mg 1,10-phenanthroline monohydrate (L1; 3 mmol,) were dissolved in 30 mL ethanol by stirring for 30 minutes at room temperature. To this solution, 1.25 g colloidal silica aqueous solution (Ludox HS-40, 40 wt%,) was added and continued stirring for 20 hours at 60 °C. Then, the reaction mixture was cooled to room temperature and the solvent was removed by rotary evaporation and dried under high vacuum. The obtained solid material (Co-L1-SiO_2, ~1168 mg, 88%) was grounded to a fine powder and transferred to crucible. The crucible was closed with a lid and placed in a pyrosis oven and then heated to the defined temperature (400, 600, 800, and 1000 °C) for 2 h at the heating rate of 5 °C/min under Argon gas. After the completion of pyrolysis, the oven was cooled down to room temperature and the material was removed from the oven (Co-L1/SiO_2-800, ~898 mg, 67%). Next, the obtained samples were etched in 5 M NH_4HF_2 aqueous solution at room temperature for 24 h to remove the SiO_2 template and larger particles. Finally, the resulting catalytic material was filtered and washed subsequently with deionized water and ethanol for three times and finally dried under vacuum (Co-

NC-L1@800, ~375 mg, 28.2%). The catalyst was named as Co-NC-L1@T (T represented the pyrolysis temperature). Elemental Analysis of optimal catalyst, Co-NC-L1@800: Co=1.7 wt%, C=78.1 wt%, N=3.72 wt%, H=0.79 wt%, Si=0.2 wt%). The same procedure was applied for the preparation of other catalysts using different ligands such as 2,2'-bipyridine (L2), 2,2';6',2''-terpyridine (L3), and 2,6-bis(2-benzimidazolyl)pyridine (L4).

S3 Characterization of catalysts

XRD patterns

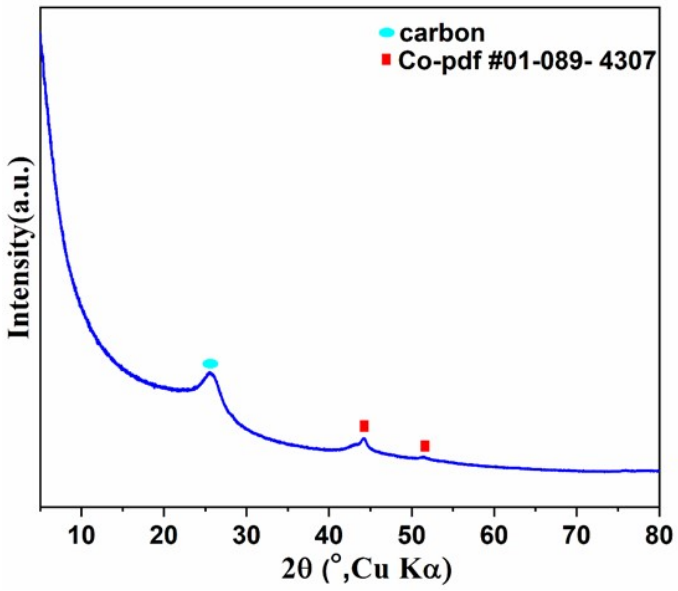


Figure S1. XRD pattern of Co@NC-800-L1 catalyst.

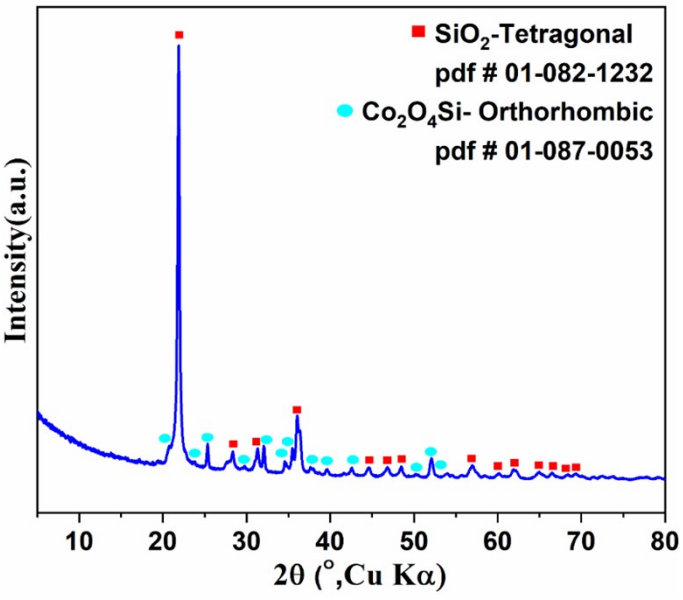


Figure S2. XRD pattern of cobalt particles-800 catalyst (prepared without ligand).

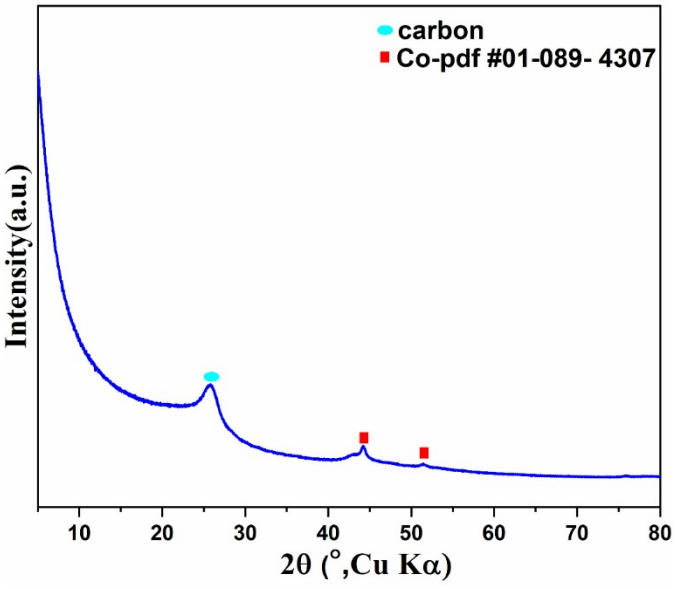


Figure S3. XRD pattern of Co@NC-800-L1-R recycled catalyst.

TEM images

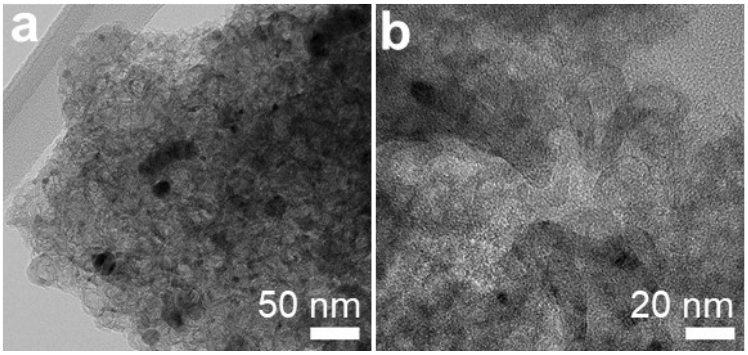


Figure S4. TEM images of Co@NC-800-L1-R recycled catalyst.

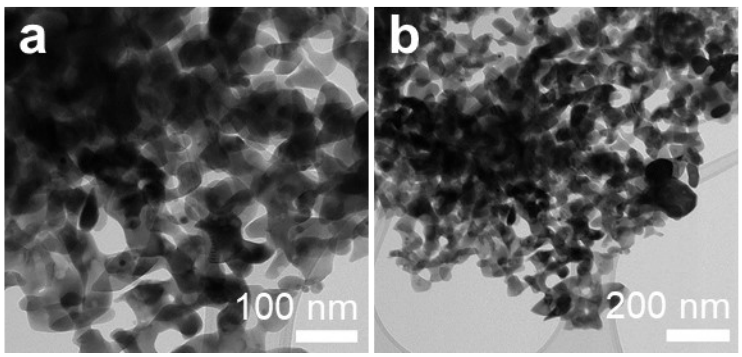


Figure S5. TEM images of cobalt particles-800 catalyst (prepared without ligand).

XPS spectra

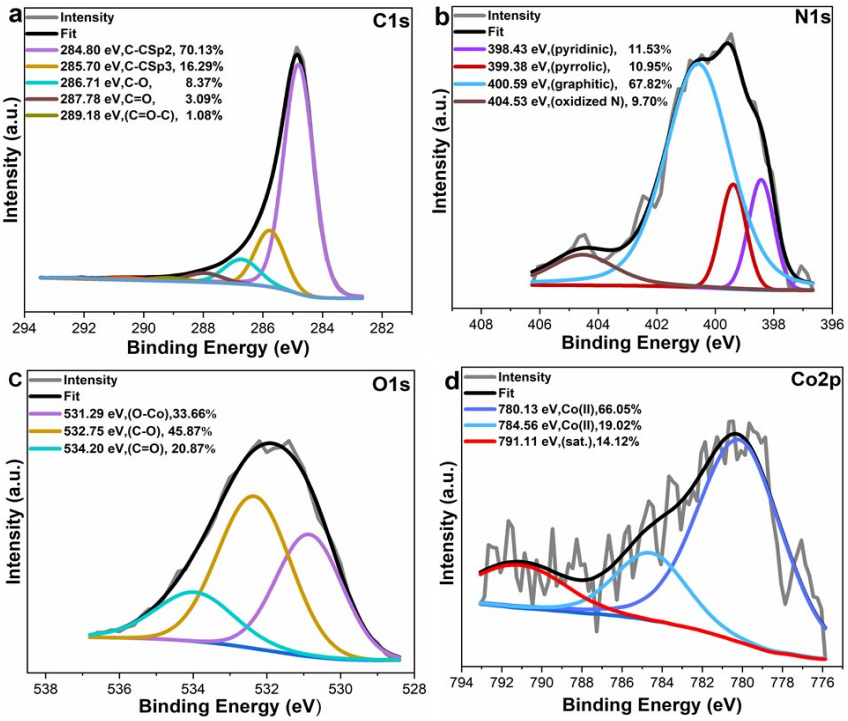


Figure S6. High resolution X-ray photoelectron spectra (HR-XPS) for Co@NC-800-L1-R recycled catalyst. a) C1s, b) N1s, c) O1s and d) Co2p region.

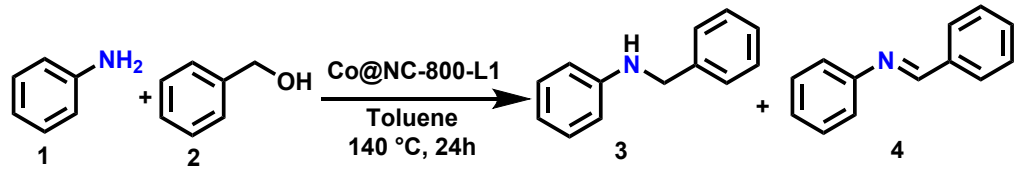
S4. General procedure for the N-alkylation of amines with alcohols

S4.1 N-Alkylation of amines with alcohols

The magnetic stirring bar, 0.5 mmol amine and 1 mmol alcohol, 15 mg catalyst (Co-NC-L1@800 and 0.5 mmol t-BuOK were transferred to 20 mL pressure tube. Then, 2 mL dry toluene was added, and the pressure tube was flushed with argon and fitted with screw cap. The pressure tube containing reaction mixture was placed in aluminum block and reaction was allowed to progress under stirred condition at 140 °C for 24 h. After the completion of the reaction, the pressure tube was cooled to room temperature and the cap was slowly removed. Then, the reaction products were removed from the pressure tube, and the solid catalyst was filtered off and washed thoroughly with ethyl acetate. The reaction products were analyzed by GC-MS. The corresponding secondary amines were purified by column chromatography (silica; pentene-ethyl acetate mixture) and characterized by NMR, GCMS and HRMS spectral analysis. Following procedure is applied for determining the conversion and yield by GC: After completion of the reaction, n-hexadecane (50 µL) as standard was added to the reaction

pressure tube and the reaction products were diluted with ethyl acetate followed by filtration using plug of silica. Then the filtrate containing products were analyzed by GC.

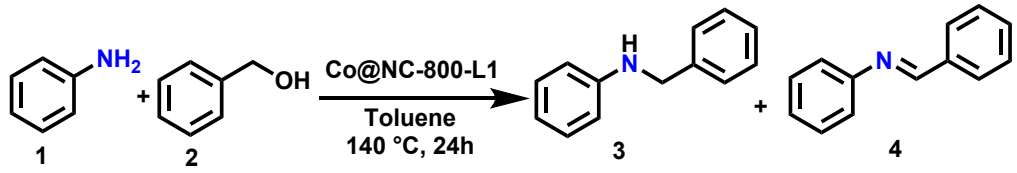
Table S1. N-Alkylation of aniline with benzyl alcohol: Testing of cobalt catalysts [a].



Entry	Catalyst	Conv. 1 (%)	Yield 3 (%)	Yield 4 (%)
1	Co@NC-800-L1	>99	99	-
2	Co@NC-800-L2	>99	96	5
3	Co@NC-800-L3	96	87	8
4	Co@NC-800-L4	90	81	8
5	Co@NC-400-L1	75	44	29
6	Co@NC-600-L1	93	80	10
7	Co@NC-1000-L1	>99	88	9
8	Co-particles-800 (without ligand)	84	56	27
9	Co@NC-800-L1-SiO_2 (with SiO_2)	67	43	21
10 [b]	Co@NC-800-L1 (without base)	86	57	27
11 [c]	1 equivalent of t-BuOK	21	15	5
12	$Co(NO_3)_2$-L1-SiO_2 (Unpyrolyzed)	23	17	5
13	$Co(NO_3)_2.6H_2O$	30	23	6
14	$Co(NO_3)_2$-L1	40	31	7
15	NC-800-L1 (without cobalt)	23	18	5

[a] Reaction conditions: 0.5 mmol aniline, 1 mmol benzyl alcohol, 15 mg catalyst (0.86 mol% Co), 0.5 mmol t-BuOK (1 equiv.), 2 mL toluene, 140 °C, 24 h. For homogeneous catalysis conditions, 1 mmol cobalt nitrate and 3 mmol ligand were used. [b] Without base. [c] Without catalyst and in presence of 0.5 mmol t-BuOK (1 equiv.). Conversions and yields are based on aniline and determined by GC using n-hexadecane standard.

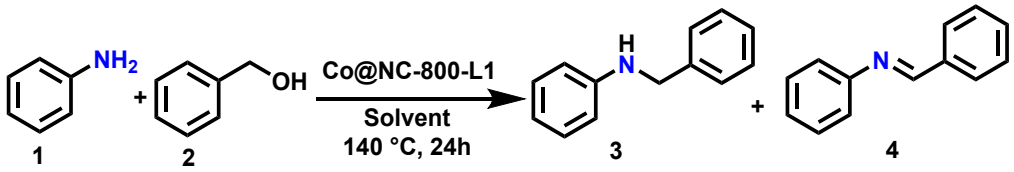
Table S2. N-Alkylation of aniline with benzyl alcohol: Testing of different bases.



Entry	Base	Conv. 1 (%)	Yield 3 (%)	Yield of 4 (%)
1	Cs_2CO_3 (1 equiv.)	62	55	6
2	K_3PO_4 (1 equiv.)	81	64	16
3	K_2CO_3 (1 equiv.)	57	23	22
4	KOH (1 equiv.)	88	74	12
5	t-BuOK (1 equiv.)	>99	99	-
6	t-BuOK (0.1 equiv.))	43	28	14
7	t-BuOK (0.2 equiv.))	80	67	11
8	t-BuOK (0.5 equiv.)	88	74	12
9	t-BuOK (0.75 equiv.)	96	88	7

Reaction conditions: 0.5 mmol aniline, 1 mmol benzyl alcohol, 20 mg catalyst (1.15 mol% Co), 2 mL toluene, 140 °C, 24 h. Conversions and yields are based on aniline and determined by GC using n-hexadecane standard.

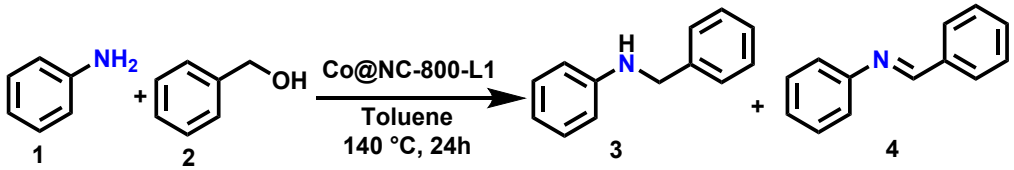
Table S3. N-Alkylation of aniline with benzyl alcohol: Testing of different solvents.



Entry	Solvent	Conv. 1 (%)	Yield 3 (%)	Yield of 4 (%)
1	o-Xylene	90	78	11
2	p-Xylene	89	72	15
3	THF	97	86	12
4	MeCN	54	43	9
5	Toluene	>99	99	-
6	Dioxane	91	80	10

Reaction conditions: 0.5 mmol aniline, 1 mmol benzyl alcohol, 20 mg catalyst (1.15 mol% Co), 2 mL 0.5 mmol, t-BuOK solvent, 140 °C, 24 h. Conversion and yields are based on aniline and determined by GC using n-hexadecane as standard.

Table S4. N-Alkylation of aniline with benzyl alcohol: Testing of different benzyl alcohol amount.



Entry	Benzyl alcohol amount	Conv. 1 (%)	Yield 3 (%)	Yield of 4 (%)
1	0.5 mmol (1 equiv.)	88	62	25
2	0.7 mmol (1.4 equiv.)	>99	93	5
3	1.0 mmol (2 equiv.)	>99	99	-

Reaction conditions: 0.5 mmol aniline, 20 mg catalyst (1.15 mol% Co), 0.5 mmol t-BuOK, 2 mL toluene, 140 °C, 24 h. Conversions and yields are based on aniline and determined by GC using n-hexadecane standard.

Table S5. Comparison of activities of our Co-catalyst with previously reported heterogeneous catalysts.

Entry	Catalyst	Reaction conditions	Yield. %	Sel. %	Catalyst loading	Ref.
1	**Co@NC-800-L1**	140 °C, 24 h,	99%	99%	0.86 mol% Co	this work
2	Pd@SiO_2	150 °C, 30 h	97%	--	1 mol% Pd	(22a)
3	Pd/MgO	180 °C, 0.25 h.	79%	80%	0.8% Pd	(22b)
4	Ni/$CaSiO_3$	155 °C, 17 h	78%	78%	2 mol% Ni	(23a)
5	Ni/θ-Al_2O_3	144 °C, 3 h	99%	99%	1 mol% Ni	(23b)
6	Ni/Al_2O_3	150 °C, 72 h	78%	79%	5 mol% Ni	(24)
7	15Ni/Al-β-CD	140 °C, 1 h	38%	64%	35 mg	(25)
8	$Ni(COD)_2$	140 °C, 18 h	99%	99%	3 mol%	(26)
9	NiCuFeOx	Reflux in xylene solvent, 24 h	--	94%	50 mg (>30 mol% of Ni+Cu)	(27)
10	Cu@ Mg–Al hydrotalcite	180 °C, 15 h	98%	98%	--	(30)
11	Copper Powder	160 °C, 24 h	99%	99%	3 mol% Cu	(32)

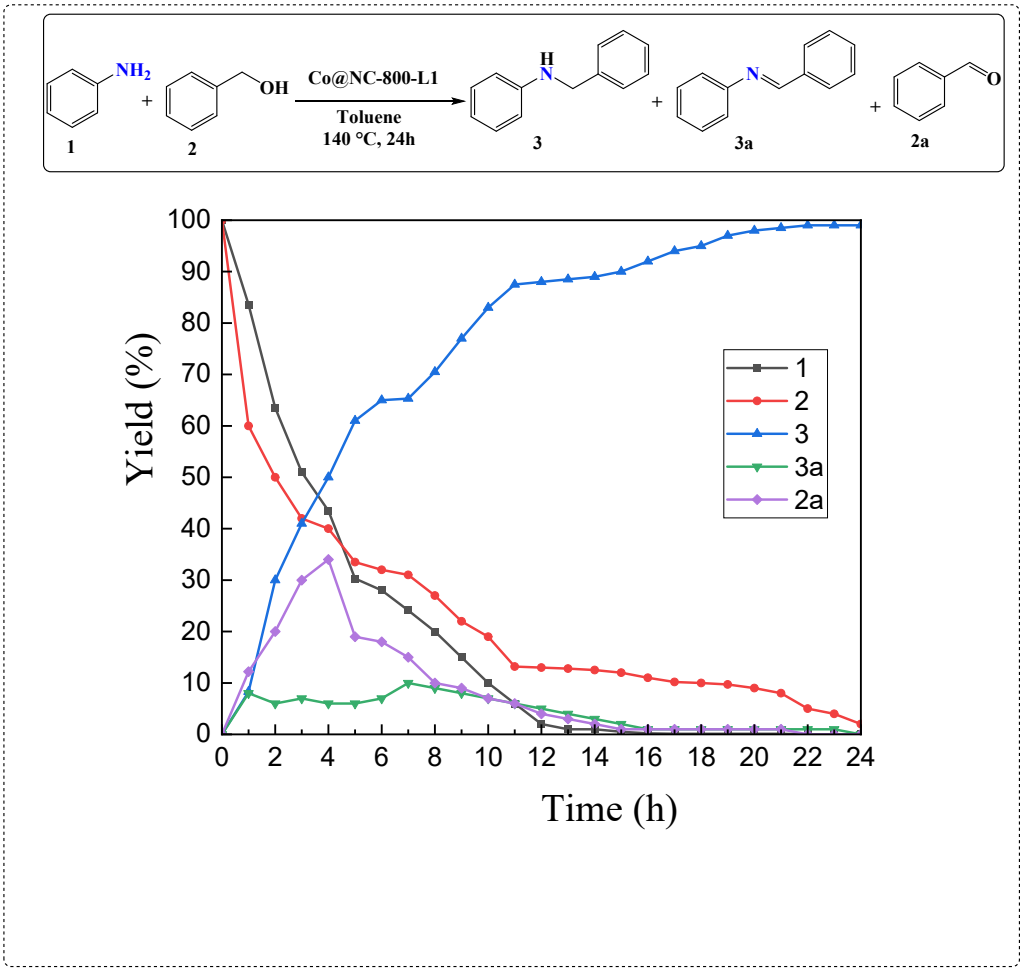


Figure S7. N-Alkylation of aniline with benzyl alcohol: Reaction progress with time.

Reaction conditions: 0.5 mmol aniline, 1 mmol benzyl alcohol, 15 mg catalyst, 0.5 mmol t-BuOK, 2 mL toluene, 140 °C, 24 h. Conversions and yields are based on aniline and determined by GC using n-hexadecane standard.

S4.2 Methylation of anilines

The magnetic stirring bar, 0.5 mmol aniline, 50 mg Co-NC-L1@800 and 1 mmol t-BuOK were transferred to 20 mL pressure tube and 2 mL methanol was added. Then, the pressure tube was flushed with argon and closed with screw cap. The pressure tube containing reaction mixture was placed into aluminum block and allowed to progress at 160 °C for desired time. After the completion of the reaction, the pressure tube was cooled to room temperature. Then, the samples were removed from pressure tube, and the solid catalyst was filtered off and washed thoroughly with ethyl acetate. The reaction products were analyzed by GC-MS. The corresponding N-methylated products were purified by column chromatography (silica; pentene-ethyl acetate mixture) and characterized by NMR and HRMS spectral analysis.

S4.3 Synthesis of primary amines using alcohols and ammonia.

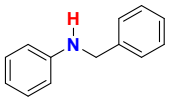
The magnetic stirring bar, 0.5 mmol corresponding alcohol, 30 mg Co-NC-L1@800 and 0.5 mmol t-BuOK were transferred to 8 mL glass vial and then 2 mL dry toluene was added. Then, the vial was fitted with septum, cap and needle. The reaction vials (8 reactions vials at a time containing different substrates) were placed into a 300 mL autoclave. The autoclave was flushed with 20 bar of nitrogen 2 times and then it was pressurized to 5-7 bar ammonia. The autoclave was placed into an aluminum block preheated at 150 °C and the reactions were stirred for required time. After the completion of the reactions, the autoclave was cooled to room temperature. The remaining ammonia was discharged, and the samples were removed from the autoclave. The solid catalyst was filtered off and washed thoroughly with ethyl acetate. The reaction products were analyzed by GC-MS. The corresponding amines were purified by column chromatography (silica; n-hexane-ethyl acetate mixture) and characterized by NMR and HRMS spectral analysis. For conversion into hydrochloride salt of amine, 1-2 mL methanolic HCl (1.5M HCl in methanol) was added to the ether solution of respective amine and stirred at room temperature for 4-5 h. Then, the solvent was removed, and the resulted hydrochloride salt of amine is dried under high vacuum.

S5 Catalyst recycling

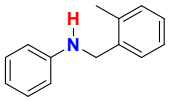
The magnetic stirring bar, 1 mmol aniline and 2 mmol benzyl alcohol, 30 mg Co-NC-L1@800 and 1 mmol t-BuOK were transferred to 20 mL pressure tube and 3 mL dry toluene was added. The pressure tube was flushed with argon and closed with screw cap. Then, it was placed into an aluminum block and heated to 140 °C for desired time. After the completion of the reaction, the pressure tube was cooled down to room temperature. To the reaction products, 100 µL n-hexadecane as standard was added. The catalyst was separated by centrifugation and the centrifugate containing reaction products was subjected to GC analysis. The separated catalyst was washed with water, methanol and ethyl acetate and then dried under vacuum. The dried catalyst was used for the next run without further purification or reactivation.

S6 NMR and HRMS data

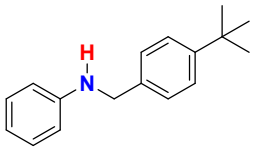
NOTE: For some compounds intensity of -NH peak is very low and hence not properly visible in ^{1}H-NMR.



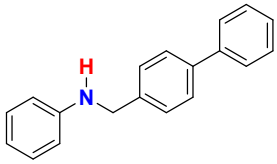
^{1}H NMR (300 MHz, Chloroform-*d*) δ 7.41-7.27 (m, 5H), 7.23 – 7.16 (m, 2H), 6.80 – 6.74 (m, 1H), 6.66 – 6.73 (m, 2H), 5.12 (bs, 1H), 4.32 (s, 2H).
^{13}C NMR (75 MHz, Chloroform-d) δ 138.6, 129.3, 128.6, 127.8, 127.4, 118.5, 113.7, 48.9.
HRMS (ESI): Calculated for $C_{13}H_{13}N$ [M+H] = 184.1126; found = 184.1126.



^{1}H NMR (300 MHz, Chloroform-*d*) δ 7.30 – 7.22 (m, 1H), 7.18 – 7.10 (m, 4H), 7.10 – 7.06 (m, 1H), 6.70 – 6.61 (m, 1H), 6.59 – 6.52 (m, 2H), 4.21 (s, 2H), 3.75 (bs, 1H), 2.23 (s, 3H).
^{13}C NMR (75 MHz, Chloroform-*d*) δ 148.3, 137.1, 136.4, 130.5, 129.3, 128.3, 127.5, 126.3, 117.5, 112.8, 46.5, 19.1.
HRMS (ESI): Calculated for $C_{14}H_{15}N$ [M+H] = 198.1283; found = 198.1278.
Yield of product 5: 85%; 84.0 mg, 0.424 mmol.

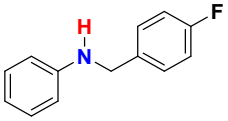


^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.41 – 7.36 (m, 2H), 7.35 – 7.30 (m, 2H), 7.21 – 7.15 (m, 2H), 6.75 – 6.70 (m, 1H), 6.69 – 6.63 (m, 2H), 4.29 (s, 2H), 1.33 (s, 9H).
^{13}C NMR (101 MHz, Chloroform-*d*) δ 150.3, 148.2, 136.3, 129.7, 129.3, 127.4, 126.0, 125.6, 117.6, 112.2, 48.1, 31.4, 31.1.
HRMS (EI): Calculated for $C_{17}H_{21}N$ = 240.1752; found = 240.1750.
Yield of product 7: 84%; 101 mg, 0.42 mmol.

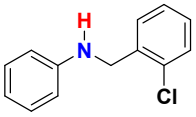


^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.65 – 7.57 (m, 4H), 7.50 – 7.43 (m, 4H), 7.40 – 7.34 (m, 1H), 7.25 – 7.19 (tt, *J* = 1.0, 7.4, 2H), 6.80 – 6.74 (td, *J* = 1.1, 7.3, 1H), 6.72 – 6.67 (m, 2H), 4.38 (s, 2H), 4.25 (bs, 1H).

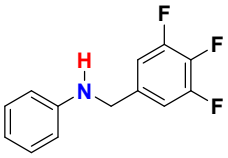
^{13}C NMR (101 MHz, Chloroform-*d*) δ 148.0, 140.9, 140.3, 138.4, 129.3, 128.8, 127.9, 127.4, 127.3, 127.1, 117.7, 113.0, 48.1.
HRMS (EI): Calculated for $C_{19}H_{17}N$ = 259.1355; found = 259.1357.
Yield of product 8: 86%; 112 mg, 0.43 mmol.



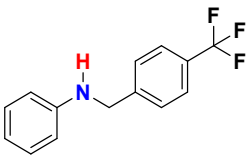
^{1}H NMR (300 MHz, Chloroform-*d*) δ 7.19 – 6.99 (m, 4H), 6.88 (t, *J* = 4.3 Hz, 2H), 6.59 (dd, *J* = 7.9, 6.7 Hz, 1H), 6.53 – 6.43 (m, 2H), 4.15 (s, 2H), 3.84 (bs, 1H).
^{13}C NMR (75 MHz, Chloroform-d) δ 163.7, 147.9, 135.2, 135.1, 129.3, 129.1, 128.9, 117.7, 115.6, 115.5, 115.3, 115.2, 112.9, 47.6.
^{19}F NMR (376 MHz, Chloroform-*d*) δ -125.77.
HRMS (ESI): Calculated for $C_{13}H_{12}NF$ [M+H] = 201.1073; found = 201.1071.
Yield of product 9: 82%; 82.4 mg, 0.41 mmol.



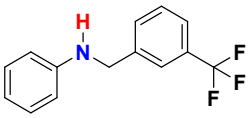
^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.34 – 7.28 (m, 2H), 7.17 – 7.05 (m, 5H), 6.67 – 6.62 (tt, *J* = 1.1, 7.3, 1H), 6.56 – 6.52 (m, 2H), 4.35 (s, 2H), 4.11 (bs, 1H).
^{13}C NMR (101 MHz, Chloroform-*d*) δ 147.7, 136.7, 133.2, 129.5, 129.3, 129.1, 128.4, 126.9, 117.8, 112.9, 45.9.
HRMS (ESI): Calculated for $C_{14}H_{12}NCl$ [M+H] = 218.0736; found = 218.0736.
Yield of product 10: 84%; 91.6 mg, 0.42 mmol.



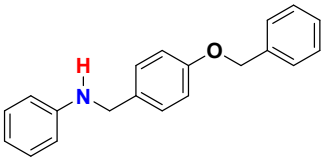
^{1}H NMR (300 MHz, Chloroform-*d*) δ 7.14 – 7.03 (m, 2H), 6.99 – 6.82 (m, 2H), 6.76 – 6.63 (m, 1H), 6.53 – 6.44 (m, 2H), 4.20 (s, 2H), 4.09 (bs, 1H).
^{13}C NMR (75 MHz, Chloroform-*d*) δ 153.1, 152.9, 149.8, 149.6, 147.2, 140.3, 136.2, 129.4, 118.3, 112.9, 110.9, 110.8, 110.7, 110.6, 47.1.
^{19}F NMR (282 MHz, Chloroform-d) δ -137.83, -167.15.
HRMS (ESI): Calculated for $C_{14}H_{10}NF_3$ [M+H] = 238.0843; found = 238.0848.
Yield of product 11: 87%; 103.6 mg, 0.435 mmol.



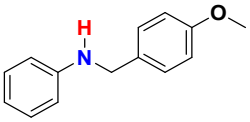
^{1}H NMR (300 MHz, Chloroform-*d*) δ 7.63 – 7.46 (m, 4H), 7.25 – 7.12 (m, 2H), 6.79 – 6.71 (m, 1H), 6.66 – 6.58 (m, 2H), 4.42 (s, 2H).
^{13}C NMR (75 MHz, Chloroform-*d*) δ 162.4, 139.7, 136.4, 130.2, 122.6, 32.3, 20.8.
^{19}F NMR (282 MHz, Chloroform-d) δ -62.47.
HRMS (ESI): Calculated for $C_{14}H_{12}NF_3$ [M+H] = 252.1000; found = 252.1004.
Yield of product 12: 80%; 101 mg, 0.40 mmol.



^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.62 – 7.58 (m, 1H), 7.56 – 7.48 (dd, *J* = 7.9, 15.6, 2H), 7.45 – 7.40 (m, 1H), 7.18 – 7.13 (m, 2H), 6.79 – 6.68 (m, 1H), 6.64 – 6.56 (m, 2H), 4.35 (s, 2H), 4.31 (bs, 1H).
^{13}C NMR (101 MHz, Chloroform-*d*) δ 147.5, 140.4, 130.7, 129.3, 129.3, 129.2, 129.1, 124.2, 124.1, 124.1, 120.8, 118.2, 113.1, 48.0.
^{19}F NMR (282 MHz, Chloroform-d) δ -62.66.
HRMS (ESI): Calculated for $C_{14}H_{12}NF_3$ [M+H] = 252.1000; found = 252.1003.
Yield of product 13: 82%; 103.4 mg, 0.41 mmol.



^{1}H NMR (300 MHz, DMSO-d_6) δ 7.45 – 7.44 (d, *J* = 0.6, 2H), 7.43 – 7.42 (t, *J* = 0.8, 2H), 7.41 – 7.40 (m, 3H), 7.25 – 7.23 (q, *J* = 1.4, 2H), 7.01 – 6.94 (m, 2H), 6.77 – 6.72 (m, 1H), 6.69 – 6.65 (m, 2H), 6.16 (bs, 1H), 5.15 (s, 2H), 4.21 (s, 2H).
^{13}C NMR (101 MHz, DMSO-d6) δ 157.6, 149.1, 137.6, 132.7, 129.2, 128.9, 128.8, 128.2, 128.1, 116.1, 115.1, 112.8, 69.6, 46.4.
HRMS (EI): Calculated for $C_{21}H_{23}ON$ = 306.1571; found = 306.1569.
Yield of product 14: 85%; 130.1 mg, 0.425 mmol.

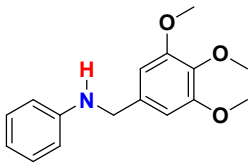


^{1}H NMR (300 MHz, Chloroform-*d*) δ 7.22 – 7.16 (m, 2H), 7.12 – 7.03 (m, 2H), 6.81 – 6.74 (m, 2H), 6.65 – 6.58 (m, 1H), 6.57 – 6.51 (m, 2H), 4.15 (s, 2H), 3.92 (bs, 1H), 3.66 (s, 3H).

^{13}C NMR (75 MHz, Chloroform-*d*) δ 158.9, 148.1, 131.3, 129.2, 128.8, 117.6, 114.0, 112.9, 55.3, 47.8.

HRMS (ESI): Calculated for $C_{14}H_{15}NO$ [M+H] = 214.1232; found =214.1232.

Yield of product 15: 88%; 94.2 mg, 0.44 mmol.

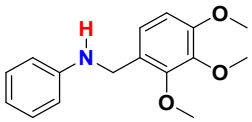


^{1}H NMR (300 MHz, Chloroform-*d*) δ 7.20 – 7.15 (m, 2H), 6.67 – 6.65 (dd, *J* = 0.9, 2.1, 2H), 6.64 – 6.60 (m, 3H), 4.25 (s, 2H), 3.83 (s, 9H), 3.56 (bs, 1H).

^{13}C NMR (75 MHz,) δ 153.4, 148.2, 137.0, 135.2, 129.2, 117.7, 112.9, 104.3, 60.8, 56.1, 48.7.

HRMS (EI): Calculated for $C_{16}H_{19}NO_3$ = 273.1359; found = 273.1357.

Yield of product 17: 81%; 110.5 mg, 0.405 mmol.

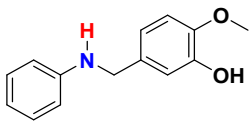


^{1}H NMR (300 MHz, Chloroform-*d*) δ 7.22 – 7.13 (m, 2H), 7.05– 6.98 (dd, *J* = 0.6, 8.5, 1H), 6.71 – 6.61 (m, 4H), 4.30 (s, 2H), 3.93 (s, 3H), 3.90 (s, 3H), 3.84 (s, 3H).

^{13}C NMR (75 MHz, Chloroform-d) δ 153.1, 151.9, 148.3, 142.2, 129.2, 125.1, 123.4, 117.4, 113.0, 107.2, 61.1, 60.8, 56.0, 43.2.

HRMS (EI): Calculated for $C_{16}H_{19}NO_3$ = 273.1359; found =273.1356.

Yield of product 18: 80%; 108.9 mg, 0.40 mmol.

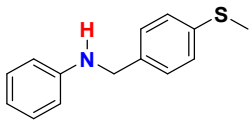


^{1}H NMR (300 MHz, Chloroform-*d*) δ 7.12 – 7.00 (m, 2H), 6.88 – 6.80 (m, 1H), 6.77 – 6.56 (m, 3H), 6.54 – 6.47 (m, 2H), 4.74 (bs, 1H), 4.09 (s, 2H), 3.71 (s, 3H).

^{13}C NMR (75 MHz, Chloroform-*d*) δ 148.2, 145.8, 145.8, 132.7, 129.3, 119.1, 117.5, 113.9, 112.9, 110.8, 56.0, 47.9.

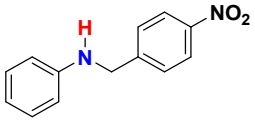
HRMS (EI): Calculated for $C_{14}H_{15}NO_2$ = 229.1097; found = 229.1093.

Yield of product 19: 80%; 91.6 mg, 0.40 mmol.

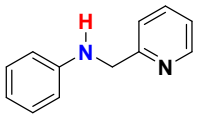


^{1}H NMR (300 MHz, Chloroform-*d*) δ 7.21 – 7.17 (m, 2H), 7.15 – 7.11 (m, 2H), 7.11 – 7.03 (m, 2H), 6.66 – 6.58 (m, 1H), 6.55 – 6.50 (m, 2H), 4.16 (s, 2H), 4.06 (bs, 1H), 2.35 (s, 3H).

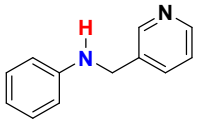
^{13}C NMR (75 MHz, Chloroform-*d*) δ 147.8, 137.2, 136.3, 130.0, 129.3, 128.1, 127.0, 125.2, 117.8, 113.0, 47.9, 16.1.
HRMS (EI): Calculated for $C_{14}H_{15}NS$ = 229.0903; found = 229.0902.
Yield of product 20: 87%; 99.6 mg, 0.435 mmol.



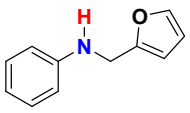
^{1}H NMR (300 MHz, Chloroform-*d*) δ 8.15 – 8.05 (m, 2H), 7.54 – 7.38 (m, 2H), 7.14 – 7.03 (m, 2H), 6.74 – 6.61 (m, 1H), 6.56 – 6.46 (m, 2H), 4.39 (s, 2H), 4.25 (bs, 1H).
^{13}C NMR (75 MHz, Chloroform-*d*) δ 147.4, 147.2, 147.2, 129.4, 127.7, 123.9, 118.3, 113.0, 47.7.
HRMS (EI): Calculated for $C_{13}H_{12}N_2O_2$ = 229.1934; found =229.1936.
Yield of product 11: 77%; 88.2 mg, 0.385 mmol.



^{1}H NMR (300 MHz, Chloroform-d) δ 8.77 – 8.41 (m, 1H), 7.68 – 7.60 (td, *J* = 1.8, 7.7, 1H), 7.38 – 7.30 (dt, *J* = 1.0, 7.8, 1H), 7.22 – 7.14 (m, 3H), 6.77 – 6.70 (m, 1H), 6.70 – 6.65 (m, 2H), 4.51 (bs, 1H), 4.45 (s, 2H).
^{13}C NMR (75 MHz, Chloroform-*d*) δ158.5, 149.1, 147.9, 136.8, 129.3, 122.1, 121.6, 117.6, 113.1, 49.2.
HRMS (ESI): Calculated for $C_{12}H_{12}N_2$ [M+H] = 185.1078; found = 185.1081.
Yield of product 24: 81%; 74.9 mg, 0.405 mmol.

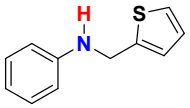


^{1}H NMR (300 MHz, Chloroform-d) δ 8.76 – 8.48 (m, 2H), 7.76 – 7.58 (m, 1H), 7.32 – 7.05 (m, 3H), 6.80 – 6.70 (tt, *J* =1.1, 7.5, 1H), 6.67 – 6.51 (m, 2H), 4.33 (s, 2H), 3.99 (bs,1 H).
^{13}C NMR (75 MHz, Chloroform-d) δ 149.1, 148.6, 147.6, 135.1, 134.9, 129.4, 123.6, 118.0, 112.9, 45.7.
HRMS (ESI): Calculated for $C_{12}H_{12}N_2$ [M+H] =185.1091; found =185.1090.
Yield of product 25: 85%; 78.7 mg, 0.425 mmol.

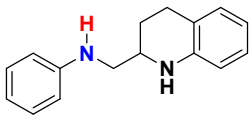


^{1}H NMR (300 MHz, Chloroform-*d*) δ 7.38 – 7.36 (m, 1H), 7.31 – 7.33 (m, 2H), 7.25 – 7.22 (m, 3H), 6.47 (dd, *J* = 3.3, 0.7 Hz, 1H), 6.26 (dd, *J* = 3.3, 1.8 Hz, 1H), 4.85 (bs, 1H), 4.43 (s, 2H).
^{13}C NMR (75 MHz, Chloroform-*d*) δ 143.6, 142.8, 129.6, 129.4, 121.1, 110.8, 110.5, 99.7, 46.3.

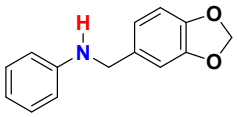
HRMS (EI): Calculated for $C_{13}H_{11}NO$ = 174.1150; found = 174.1149.
Yield of product 26: 82%; 71.4 mg, 0.41 mmol.



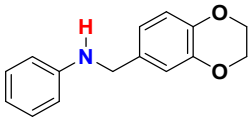
^{1}H NMR (300 MHz, Chloroform-*d*) δ 7.25 – 7.18 (m, 3H), 7.03 – 6.96 (m, 2H), 6.81 – 6.74 (tt, *J* = 1.1, 7.3, 1H), 6.73 – 6.66 (m, 2H), 4.51 (s, 2H).
^{13}C NMR (75 MHz, Chloroform-*d*) δ 129.3, 129.2, 126.9, 125.2, 124.7, 124.1, 118.4, 113.5, 43.7.
HRMS (EI): Calculated for $C_{11}H_{11}NS$ = 189.0606; found = 189.0601.
Yield of product 27: 89%; 84.1 mg, 0.445 mmol.



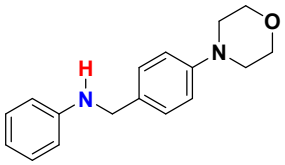
^{1}H NMR (400 MHz, Chloroform-d) δ 7.31 – 7.24 (tt, *J* = 1.0, 7.3, 2H), 7.10 – 7.02 (m, 2H), 6.84 – 6.78 (q, *J* = 1.1, 7.3, 1H), 6.76 – 6.68 (m, 3H), 6.59 – 6.54 (dd, *J* = 1.3, 8.4, 1H), 3.86 (s, 2H), 3.66 – 3.54 (m, 1H), 3.35 – 3.19 (m, 2H), 2.99 – 2.78 (m, 2H), 2.14 – 1.99 (m, 1H), 1.90 – 1.77 (m, 1H).
^{13}C NMR (101 MHz, Chloroform-d) δ 148.3, 144.3, 129.4, 129.4, 126.9, 121.4, 117.9, 117.5, 114.5, 113.1, 50.7, 49.7, 26.2.
HRMS (EI): Calculated for $C_{16}H_{18}N_2$ = 238.1464; found = 238.1459.
Yield of product 28: 74%; 88.1 mg, 0.37 mmol.



^{1}H NMR (300 MHz, CDCl3) δ 7.25 – 7.16 (m, 2H), 6.92 – 6.71 (m, 4H), 6.69 – 6.62 (m, 2H), 5.98 – 5.94 (s, 2H), 4.26 – 4.24 (d, J = 0.7 Hz, 2H), 4.16 – 3.87 (s, 1H).
^{13}C NMR (75 MHz, Chloroform-d) δ 148.0, 147.9, 146.7, 133.3, 129.3, 120.6, 117.6, 112.9, 108.3, 108.1, 101.0, 48.1.
HRMS (EI): Calculated for $C_{21}H_{23}ON$ = 229.0943; found = 227.0941.
Yield of product 29: 82%; 93.8 mg, 0.41 mmol.



^{1}H NMR (300 MHz, Chloroform-*d*) δ 7.20 – 6.36 (m, 8H), 4.16 – 4.04 (m, 6H), 3.05 (bs, 1H).
^{13}C NMR (75 MHz, Chloroform-*d*) δ 147.1, 131.9, 131.7, 128.2, 119.4, 116.4, 116.3, 115.8, 115.3, 111.7, 63.3, 63.3, 46.6.
HRMS (EI): Calculated for $C_{15}H_{15}NO_2$ = 242.1040; found = 242.1044.
Yield of product 30: 80%; 96.8 mg, 0.40 mmol.

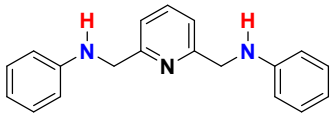


^{1}H NMR (300 MHz, Chloroform-*d*) δ 7.35 – 7.28 (m, 2H), 7.25 – 7.17 (m, 2H), 6.96 – 6.89 (m, 2H), 6.78 – 6.72 (m, 1H), 6.70 – 6.63 (m, 2H), 4.29 – 4.21 (s, 2H), 3.92 – 3.87 (m, 4H), 3.21 – 3.14 (m, 4H).

^{13}C NMR (75 MHz, Chloroform-d) δ 150.6, 148.3, 130.8, 129.3, 128.6, 117.5, 115.9, 112.9, 66.9, 49.5, 47.8.

HRMS (EI): Calculated for $C_{17}H_{20}N_2O$ = 268.1570; found = 268.1568.

Yield of product 31: 81%; 108.6 mg, 0.405 mmol.

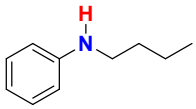


^{1}H NMR (300 MHz, Chloroform-*d*) δ 7.64 – 7.54 (m, 1H), 7.25 – 7.13 (m, 6H), 6.79 – 6.64 (m, 6H), 4.44 (s, 4H).

^{13}C NMR (75 MHz, Chloroform-*d*) δ 158.1, 147.9, 137.3, 129.3, 119.9, 117.7, 113.1, 49.3.

HRMS (EI): Calculated for $C_{19}H_{19}N_3$ = 289.1574; found = 289.1573.

Yield of product 32: 87%; 125.7 mg, 0.435 mmol.

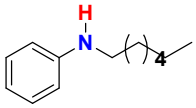


^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.24 (tt, *J* =1.0, 7.4, 2H), 6.75 (tq, *J* =1.1, 7.2, 1H), 6.66 (dq, *J* =1.0, 7.6, 2H), 3.60 (bs, 1H), 3.15 (td, *J* =0.8, 7.1, 2H), 1.76 – 1.58 (m, 2H), 1.56 – 1.40 (m, 2H), 1.10 – 0.97 (m, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 148.6,129.3, 117.1, 112.7, 43.7, 31.7, 20.4, 14.0.

HRMS (ESI): Calculated for $C_{10}H_{15}N$ [M+H] = 150.1283; found = 150.1283.

Yield of product 33: 65%; 48.8 mg, 0.325 mmol.

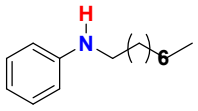


^{1}H NMR (300 MHz, Chloroform-*d*) δ 7.23 – 7.10 (m, 5H), 3.88 (bs, 1H), 3.70 – 3.41 (m, 2H), 1.48 – 1.31 (m, 2H), 1.23 – 1.06 (m, 8H), 0.92 – 0.61 (m, 3H).

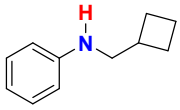
^{13}C NMR (75 MHz, Chloroform-*d*) δ 138.9, 127.6, 126.9, 125.5, 52.1, 47.6, 30.6, 27.9, 26.0, 21.4, 12.9.

HRMS (ESI): Calculated for $C_{13}H_{21}N$ [M+H] = 192.1752; found = 192.1751.

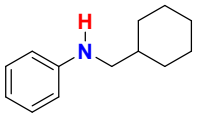
Yield of product 34: 73%; 70.1 mg, 0.365 mmol.



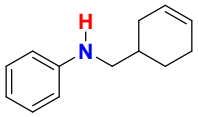
^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.23 – 7.14 (m, 2H), 6.73 (t, *J* = 7.3, 1H), 6.68 – 6.63 (m, 2H), 4.08 (bs, 1H), 3.16 – 3.06 (m, 2H), 1.63 (dd, *J* = 6.7, 8.4, 2H), 1.30 – 1.26 (m, 12H), 0.90 – 0.87 (m, 3H).
^{13}C NMR (101 MHz, Chloroform-d) δ 147.9, 129.2, 117.6, 113.2, 44.4, 31.8, 29.5, 29.4, 29.4, 29.3, 27.1, 22.6, 14.1.
HRMS (ESI): Calculated for $C_{15}H_{25}N$ [M+H] = 220.2065; found = 220.2066.
Yield of product 35: 75%; 82.5 mg, 0.375 mmol.



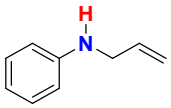
^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.21 – 7.14 (m, 2H), 6.70 (tt, *J* = 1.1, 7.3, 1H), 6.65 – 6.59 (m, 2H), 3.13 (d, *J* = 7.3, 2H), 2.60 (hept, *J* = 7.6, 1H), 2.19 – 2.07 (m, 2H), 1.99 – 1.87 (m, 2H), 1.80 – 1.71 (m, 2H).
^{13}C NMR (101 MHz, Chloroform-*d*) δ148.4, 129.2, 117.3, 112.8, 49.9, 34.9, 26.1, 18.5.
HRMS (ESI): Calculated for $C_{11}H_{15}N$ [M+H] = 162.1283; found =162.1287.
Yield of product 36: 87%; 70.5 mg, 0.435 mmol.



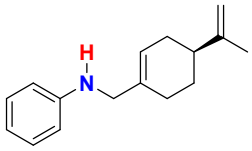
^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.18 (dd, *J* = 8.6, 7.3 Hz, 2H), 6.69 (tt, *J* = 7.3, 1.1 Hz, 1H), 6.62 (dt, *J* = 7.7, 1.1 Hz, 2H), 3.27 (s, 1H), 2.96 (d, *J* = 6.6 Hz, 2H), 1.87 – 1.80 (m, 2H), 1.78 – 1.53 (m, 4H), 1.28 (d, *J* = 2.8 Hz, 1H), 1.27 – 1.20 (m, 2H), 1.05 – 0.94 (m, 2H).
^{13}C NMR (101 MHz, Chloroform-*d*) δ 148.5, 129.2, 117.0, 112.9, 112.7, 50.7, 37.5, 31.3, 26.6, 26.0.
HRMS (EI): Calculated for $C_{13}H_{19}N$ = 189.1512; found = 189.1514.
Yield of product 37: 80%; 75.6 mg, 0.40 mmol.



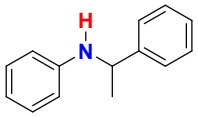
^{1}H NMR (300 MHz, Chloroform-d) δ 7.24 – 7.17 (m, 2H), 6.75 – 6.69 (dt, *J* = 1.1, 7.4 Hz, 1H), 6.67 – 6.61 (m, 2H), 5.79 – 5.57 (m, 2H), 3.95 – 3.39 (bs, 1H), 3.11 – 3.04 (d, *J* = 6.5 Hz, 2H), 2.30 – 2.06 (m, 3H), 2.01 – 1.74 (m, 3H), 1.44 – 1.30 (m, 1H).
^{13}C NMR (75 MHz, Chloroform-d) δ 148.5, 129.2, 127.2, 125.9, 117.1, 112.7, 49.7, 33.5, 29.7, 26.8, 24.7.
HRMS (ESI): Calculated for $C_{13}H_{17}N$ [M+H] = 188.1439; found = 188.1444.
Yield of product 38: 78%; 103.4 mg, 0.41 mmol.



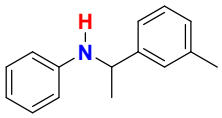
^{1}H NMR (300 MHz, Chloroform-*d*) δ 7.29 – 7.20 (m, 2H), 6.78 (ddt, *J* = 1.1, 7.3, 8.4, 1H), 6.72 – 6.65 (m, 2H), 6.02 (ddt, *J* = 17.2, 10.3, 5.4 Hz, 1H), 5.35 (dq, *J* = 1.7, 17.2, 1H), 5.22 (dq, *J* = 1.5, 10.3, 1H), 3.82 (dt, *J* = 1.6, 5.4, 2H), 3.74 (bs, 1H).
^{13}C NMR (75 MHz, Chloroform-*d*) δ 148.0, 135.5, 129.3, 117.6, 116.3, 113.1, 46.6.
HRMS (EI): Calculated for $C_9H_{11}N$ = 134.0115; found = 134.0113.
Yield of product 39: 45%; 30.15 mg, 0.225 mmol.



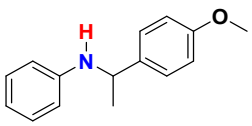
^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.25 – 7.23 (m, 1H), 7.18 – 7.09 (m, 4H), 6.70 – 6.64 (tt, *J* = 1.1, 7.4, 1H), 6.62 – 6.57 (m, 2H), 4.14 (s, 2H), 1.24 – 1.19 (m, 8H).
^{13}C NMR (101 MHz, Chloroform-*d*) δ 148.2, 148.0, 136.7, 129.3, 127.7, 126.7, 117.5, 112.9, 108.2, 48.1, 33.8, 31.5, 31.3, 24.1.
HRMS (EI): Calculated for $C_{16}H_{21}N$ = 227.1512; found = 227.1515.
Yield of product 40: 77%; 87.4 mg, 0.385 mmol.



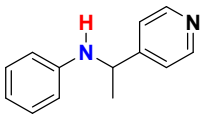
^{1}H NMR (300 MHz, Chloroform-d) δ 7.38 – 7.25 (m, 4H), 7.24 – 7.16 (m, 1H), 7.12 – 7.03 (m, 2H), 6.67 – 6.58 (m, 1H), 6.53 – 6.45 (m, 2H), 4.46 (q, *J* =6.7, 1H), 4.03 (bs, 1H), 1.49 (d, *J* =6.7, 3H).
^{13}C NMR (75 MHz, Chloroform-*d*) δ 147.2, 145.2, 129.1, 128.7, 126.9, 125.9, 117.3, 113.3, 53.5, 25.1.
HRMS (EI): Calculated for $C_{14}H_{15}N$ = 198.1460; found = 198.1458.
Yield of product 41: 84%; 83.1 mg, 0.42 mmol.



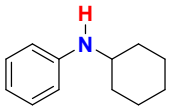
1H NMR (300 MHz, Chloroform-d) δ 7.26 – 7.03 (m, 6H), 6.67 (t, *J* =1.1, 7.4, 1H), 6.55 (d, 2H), 4.45 (q, *J* =6.7, 1H), 4.11 (bs, 1H), 2.33 (s, 3H), 1.52 (d, *J* =6.8, 3H).
^{13}C NMR (75 MHz, Chloroform-d) δ 147.3, 142.2, 138.2, 129.1, 128.5, 127.7, 126.6, 122.9, 117.3, 113.3, 53.6, 25.0, 21.5.
HRMS (EI): Calculated for $C_{15}H_{17}N$ = 212.3198; found = 212.3197.
Yield of product 42: 85%; 90.2 mg, 0.425 mmol.



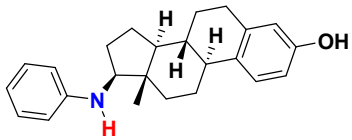
^{1}H NMR (300 MHz, Chloroform-*d*) δ 7.40 – 7.33 (m, 2H), 7.30 – 7.24 (m, 2H), 7.05 – 6.98 (m, 2H), 6.87 (tt, *J* =1.1, 7.5, 1H), 6.83 – 6.77 (m, 2H), 3.96 (s, 3H), 3.93 – 3.84 (m, 1H), 3.69 (bs, 1H), 1.30 (d, *J* =6.4, 3H).
^{13}C NMR (75 MHz, Chloroform-*d*) δ 158.2, 147.3, 130.5, 130.5, 129.4, 117.2, 113.8, 113.4, 55.2, 49.4, 20.2.
HRMS (EI): Calculated for $C_{15}H_{17}NO$ = 290.0716; found = 290.0714.
Yield of product 43: 78%; 113.1 mg, 0.39 mmol.



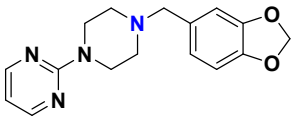
^{1}H NMR (300 MHz, Chloroform-*d*) δ 8.58 (d, *J* = 4.8, 2H), 7.37 – 7.28 (m, 2H), 7.16 – 7.03 (m, 2H), 6.78 – 6.64 (m, 1H), 6.52 – 6.39 (m, 2H), 4.46 (q, *J* = 6.8, 1H), 4.02 (bs, 1H), 1.52 (d, *J* = 6.8, 3H).
^{13}C NMR (75 MHz, Chloroform-*d*) δ 154.6, 150.1, 146.6, 129.2, 121.3, 117.8, 113.2, 52.7, 24.5.
HRMS (EI): Calculated for $C_{14}H_{18}N_2$ = 215.1239; found = 215.1237.
Yield of product 44: 80%; 85.9 mg, 0.40 mmol.



^{1}H NMR (300 MHz, Chloroform-d) δ 7.18 (td, *J* =2.0, 7.1, 2H), 6.81 – 6.55 (m, 3H), 3.50 (bs, 1H), 3.30 (tq, *J* =3.1, 3.7, 10.0, 1H), 2.10 (dp, *J* =2.7, 3.8, 12.2, 2H), 1.71 (ddq, *J* =3.9, 12.3, 32.2, 3H), 1.53 – 1.10 (m, 5H).
^{13}C NMR (101 MHz, Chloroform-d) δ 147.4, 129.3, 116.9, 113.2, 51.7, 33.5, 26.0, 25.1.
HRMS (EI): Calculated for $C_{12}H_{17}N$ = 176.0146; found =176.0143.
Yield of product 46: 75%; 66.0 mg, 0.375 mmol.



^{1}H NMR (300 MHz, DMSO-d_6) δ 9.02 (s, 1H), 7.03 (ddd, *J* =0.9, 2.7, 8.5, 3H), 6.53 – 6.43 (m, 5H), 3.57 – 3.49 (m, 2H), 2.78 – 2.66 (m, 5H), 1.64 – 1.53 (m, 2H), 1.48 – 1.06 (m, 9H), 0.81 (s, 3H).
^{13}C NMR (75 MHz, DMSO-d_6) δ 155.5, 155.3, 137.6, 130.9, 130.3, 126.4, 115.4, 115.3, 113.2, 113.1, 80.5, 49.9, 47.8, 44.0, 43.2, 37.0, 30.3, 29.6, 27.4, 26.5, 23.2, 13.9, 11.7.
HRMS (EI): Calculated for $C_{24}H_{29}NO$ = 348.0579; found = 348.0573.
Yield of product 47: 60%; 104.3 mg, 0.30 mmol.

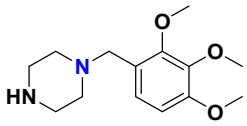


^{1}H NMR (300 MHz, Chloroform-*d*) δ 8.40 – 8.17 (dd, *J* = 0.6, 4.7, 2H), 6.94 – 6.81 (t, *J* = 1.0, 1H), 6.82 – 6.66 (t, *J* = 0.7, 2H), 6.53 – 6.35 (td, *J* = 0.7, 4.7, 1H), 5.91 (s, 2H), 3.84 – 3.71 (m, 4H), 3.43 (s, 2H), 2.54 – 2.31 (m, 4H).

^{13}C NMR (75 MHz, Chloroform-*d*) δ 161.6, 157.6, 147.7, 146.7, 131.8, 122.2, 109.7, 109.5, 107.9, 100.9, 62.8, 52.8, 43.6.

HRMS (ESI): Calculated for $C_{16}H_{18}N_4O_2$ [M+H] = 299.1508; found = 299.1508.

Yield of product 48: 90%; 134.5 mg, 0.45 mmol.

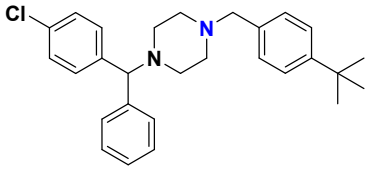


1 H NMR (300 MHz, DMSO-d6) δ 7.39 (d, *J* = 8.7 Hz, 1H), 6.90 (d, *J* = 8.7 Hz, 1H), 4.25 (s, 2H), 3.88 (s, 3H), 3.83 (s, 3H), 3.77 (s, 3H), 3.64 – 3.14 (m, 8H).

^{13}C NMR (75 MHz, DMSO-d_6) δ 155.4, 153.1, 141.7, 128.5, 114.4, 108.2, 61.7, 60.9, 56.4, 47.3, 40.2.

HRMS (EI): Calculated for $C_{14}H_{22}N_2O_3$ = 267.1045; found = 267.1043.

Yield of product 49: 81%; 108.1 mg, 0.405 mmol.

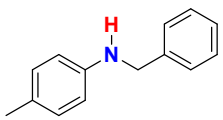


^{1}H NMR (300 MHz, CDCl3) δ 7.31 – 7.21 (m, 7H), 7.20 – 7.11 (m, 6H), 4.25 – 4.05 (s, 1H), 3.45 – 3.39 (s, 2H), 2.50 – 2.11 (s, 8H), 1.25 – 1.23 (s, 9H).

^{13}C NMR (75 MHz, Chloroform-d) δ 149.9, 142.2, 141.5, 134.8, 132.5, 129.2, 129.0, 128.6, 127.9, 127.1, 125.5, 125.1, 75.4, 62.7, 53.3, 51.8, 34.4, 31.4.

HRMS (EI): Calculated for $C_{28}H_{33}N_2Cl$ = 434.1122; found = 434.1120.

Yield of product 50: 82%; 177.9 mg, 0.41 mmol.

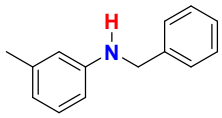


^{1}H NMR (300 MHz, Chloroform-*d*) δ 7.45 – 7.27 (m, 5H), 7.07 – 6.99 (m, 2H), 6.65 – 6.57 (m, 2H), 4.30 (s, 2H), 3.90 (bs, 1H), 2.29 (s, 3H).

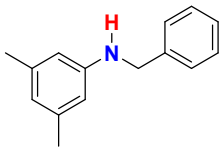
^{13}C NMR (75 MHz, Chloroform-*d*) δ 145.9, 139.6, 129.8, 128.6, 127.5, 127.2, 126.8, 113.1, 48.7, 20.4.

HRMS (EI): Calculated for $C_{14}H_{15}N$ = 198.0319; found = 198.0317.

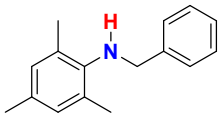
Yield of product 51: 84%; 83.1 mg, 0.42 mmol.



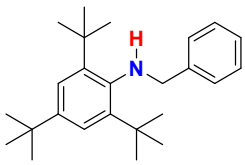
^{1}H NMR (300 MHz, Chloroform-*d*) δ 7.44 – 7.25 (m, 5H), 7.14 – 7.07 (m, 1H), 6.60 (t, *J* =0.8, 1H), 6.54 – 6.46 (m, 2H), 4.33 (s, 2H), 4.03 (bs, 1H), 2.33 (s, 3H).
^{13}C NMR (75 MHz, Chloroform-*d*) δ 148.2, 139.5, 139.1, 129.2, 128.7, 127.6, 127.2, 118.6, 113.7, 110.0, 48.4, 21.7.
HRMS (EI): Calculated for $C_{14}H_{15}N$ = 198.2846; found = 198.2844.
Yield of product 52: 80%; 79.3 mg, 0.40 mmol.



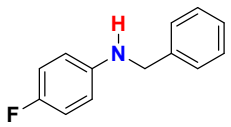
^{1}H NMR (300 MHz, Chloroform-*d*) δ 7.23 – 7.16 (m, 5H), 7.08 (m, 1H), 6.24 (s, 1H), 6.16 (s, 2H), 4.59 (bs, 1H), 4.15 (s, 2H), 2.07 (s, 6H).
^{13}C NMR (75 MHz, Chloroform-*d*) δ 148.3, 139.6, 138.9, 128.6, 127.5, 127.1, 119.5, 110.7, 48.3, 21.5.
HRMS (ESI): Calculated for $C_{15}H_{17}N$ [M+H] = 212.1439; found = 212.1442.
Yield of product 53: 86%; 91.2 mg, 0.43 mmol.



^{1}H NMR (300 MHz, Chloroform-*d*) δ 7.43 – 7.26 (m, 5H), 6.83 – 6.68 (m, 2H), 4.05 – 4.00 (m, 2H), 2.16 (s, 9H).
^{13}C NMR (75 MHz, Chloroform-*d*) δ 140.5, 131.8, 130.2, 129.6, 129.3, 128.9, 128.6, 128.2, 128.1, 127.3, 53.3, 20.7, 18.3.
HRMS (ESI): Calculated for $C_{16}H_{19}N$ [M+H] = 226.1595; found = 226.1595.
Yield of product 54: 73%; 82.5 mg, 0.365 mmol.



^{1}H NMR (400 MHz, Chloroform-d) δ 8.03 – 7.98 (m, 1H), 7.87 – 7.78 (m, 1H), 7.72 – 7.58 (m, 1H), 7.57 – 7.46 (m, 2H), 7.26 (s, 2H), 4.63 – 4.05 (m, 2H), 1.52 (s, 18H), 1.32 (s, 9H).
^{13}C NMR (101 MHz, Chloroform-d) δ140.8, 139.2, 134.9, 133.6, 132.4, 130.1, 129.9, 129.1, 128.3, 121.9, 34.8, 34.4, 31.7, 30.3.
HRMS (EI): Calculated for $C_{25}H_{37}N$ = 352.0833; found = 352.0831.
Yield of product 55: 65%; 114.1 mg, 0.325 mmol.



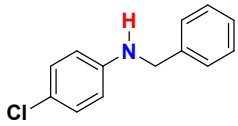
^{1}H NMR (400 MHz, Chloroform-d) δ 7.38–7.30 (m, 4H), 7.30–7.24 (m, 1H), 6.91–6.83 (m, 2H), 6.58–6.51 (m, 2H), 4.27 (s, 2H), 3.98 (bs, 1H).

^{13}C NMR (101 MHz, Chloroform-d) δ 155.9, 144.4, 139.2, 128.71, 127.54, 127.36, 115.7, 113.7, 48.9.

^{19}F NMR (376 MHz, Chloroform-d) δ -127.78.

HRMS (EI): Calculated for $C_{13}H_{12}NF$ = 201.0948; found = 201.0943.

Yield of product 56: 80%; 80.4 mg, 0.40 mmol.

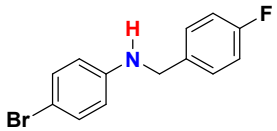


^{1}H NMR (300 MHz, Chloroform-d) δ 7.30 – 7.19 (m, 5H), 7.07– 6.99 (m, 2H), 6.51– 6.43 (m, 2H), 4.22 (s, 2H), 4.76 (bs, 1H).

^{13}C NMR (75 MHz, Chloroform-*d*) δ 146.5, 138.8, 129.1, 128.7, 127.5, 127.4, 122.2, 114.0, 48.4.

HRMS (EI): Calculated for $C_{13}H_{12}NCl$ = 217.0652; found = 217.0645.

Yield of product 57: 81%; 87.8 mg, 0.405 mmol.



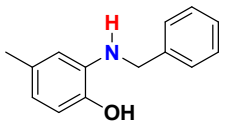
^{1}H NMR (300 MHz, Chloroform-d) δ 7.24 – 7.04 (m, 4H), 6.89 (d, *J* = 8.7 Hz, 2H), 6.34 (d, *J* = 8.9 Hz, 2H) 4.11 (s, 2H), 4.08 (bs, 1H).

^{13}C NMR (75 MHz, Chloroform-d) δ 162.1, 146.9, 134.6, 132.0, 129.0, 115.6, 114.5, 109.3, 47.5.

^{19}F NMR (376 MHz, Chloroform-d) δ -122.23.

HRMS (EI): Calculated for $C_{13}H_{11}BrFN$ = 281.0146; found = 281.0144.

Yield of product 58: 74%; 104 mg, 0.37 mmol.

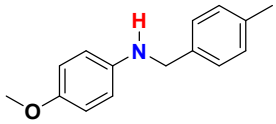


^{1}H NMR (300 MHz, Chloroform-d) δ 7.26 – 7.22 (m, 2H), 7.16 (dd, *J* = 1.7, 0.8 Hz, 1H), 7.06 – 6.96 (m, 4H), 6.69 (dq, *J* = 1.4, 0.7 Hz, 1H), 3.99 (s, 2H), 2.16 (s, 3H).

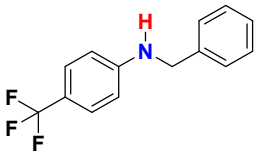
^{13}C NMR (75 MHz, Chloroform-*d*) δ 139.5, 134.8, 131.5, 128.9, 128.6, 127.6, 127.0, 126.4, 123.9, 117.8, 36.1, 21.5.

HRMS (EI): Calculated for $C_{14}H_{15}NO$ = 214.2803; found = 214.0801.

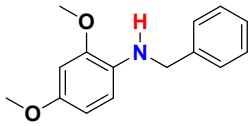
Yield of product 59: 86%; 92.1 mg, 0.43 mmol.



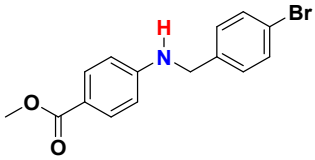
^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.31 – 7.24 (d, *J* = 5.9, 2H), 7.20 – 7.13 (m, 2H), 6.84 – 6.75 (m, 2H), 6.65 – 6.57 (m, 2H), 4.20 (s, 2H), 3.72 (s, 3H), 3.60 (bs, 1H), 2.31 (s, 3H).
^{13}C NMR (101 MHz, Chloroform-*d*) δ 152.2, 142.6, 136.8, 136.7, 129.3, 127.6, 114.9, 114.1, 55.8, 49.0, 21.1.
HRMS (EI): Calculated for $C_{15}H_{17}NO$ = 228.2043; found = 228.2041.
Yield of product 60: 85%; 96.9 mg, 0.425 mmol.



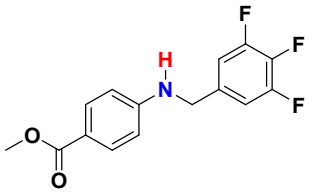
^{1}H NMR (300 MHz, Chloroform-d) δ 7.45 – 7.27 (m, 7H), 6.69 – 6.53 (m, 2H), 4.34 (s, 2H).
^{13}C NMR (75 MHz, Chloroform-*d*) δ 128.8, 127.5, 127.3, 126.6, 126.6, 112.0, 47.8.
^{19}F NMR (282 MHz, Chloroform-d) δ -61.03.
HRMS (EI): Calculated for $C_{15}H_{16}NF_3$ = 268.0178; found = 268.0176.
Yield of product 61: 80%; 107.1 mg, 0.40 mmol.



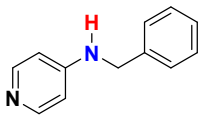
^{1}H NMR (300 MHz, Chloroform-*d*) δ 7.43 – 7.26 (m, 5H), 6.56 – 6.50 (m, 2H), 6.42 – 6.38 (m, 1H), 4.33 (s, 2H), 3.85 (s, 3H), 3.77 (s, 3H).
^{13}C NMR (75 MHz, Chloroform-*d*) δ 152.1, 147.9, 139.8, 132.5, 128.5, 127.6, 127.1, 110.4, 103.7, 99.2, 55.8, 55.5, 48.8.
HRMS (ESI): Calculated for $C_{15}H_{17}NO_2$ [M+H] = 244.1337; found = 244.1337.
Yield of product 64: 78%; 95.2 mg, 0.39 mmol.



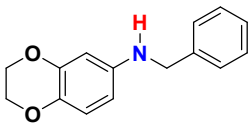
^{1}H NMR (300 MHz, Chloroform-d) δ 7.84 – 7.72 (m, 2H), 7.36 – 7.26 (m, 2H), 7.14 – 7.04 (m, 2H), 6.59 – 6.44 (m, 2H), 4.90 (bs, 1H), 4.30 (s, 2H), 3.80 (s, 3H),
^{13}C NMR (75 MHz, Chloroform-d) δ 167.2, 150.9, 137.1, 131.8, 131.5, 129.1, 121.3, 119.4, 112.2, 51.7, 47.4.
HRMS (EI): Calculated for $C_{15}H_{14}BrNO_2$ = 321.0134; found = 321.0132.
Yield of product 65: 72%; 115.4 mg, 0.36 mmol.



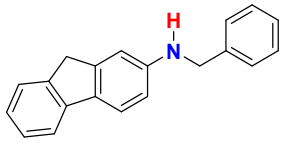
^{1}H NMR (300 MHz, DMSO-d_6) δ 7.71 – 7.62 (m, 2H), 7.36 – 7.23 (m, 2H), 7.19 (bs, 1H), 6.73 – 6.57 (m, 2H), 4.46 (s, 2H), 3.73 (s, 3H).
^{13}C NMR (75 MHz, DMSO-d6) δ 166.7, 152.5, 152.3, 149.0, 139.5, 137.7, 136.2, 131.3, 117.1, 111.9, 111.8, 111.7, 51.6, 45.7, 45.1, 8.8.
^{19}F NMR (282 MHz, Chloroform-d) δ -136.19, -165.50.
HRMS (EI): Calculated for $C_{15}H_{12}NO_2F_3$ = 296.0817; found = 296.0814.
Yield of product 66: 83%; 122.8 mg, 0.415 mmol.



^{1}H NMR (300 MHz, Chloroform-*d*) δ 8.22 – 8.09 (m, 2H), 7.39 – 7.27 (m, 5H), 6.55 – 6.40 (m, 2H), 4.40 – 4.33 (m, 2H).
^{13}C NMR (75 MHz, Chloroform-*d*) δ 153.6, 149.3, 137.8, 128.8, 127.6, 127.3, 107.7, 46.9.
HRMS (ESI): Calculated for $C_{12}H_{12}N_2$ [M+H] = 185.1078; found =185.1074.
Yield of product 67: 86%; 79.5 mg, 0.43 mmol.

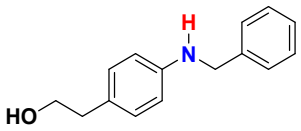


^{1}H NMR (400 MHz, Chloroform-d) δ 7.40 – 7.31 (m, 5H), 6.71 (d, *J* = 8.4 Hz, 1H), 6.22 – 6.16 (m, 2H), 4.26 (s, 2H), 4.24 – 4.20 (m, 2H), 4.20 – 4.15 (m, 2H), 3.66 (bs, 1H).
^{13}C NMR (101 MHz, Chloroform-d) δ 144.1, 143.2, 139.5, 135.8, 128.6, 127.5, 127.2, 117.6, 106.8, 101.6, 64.7, 64.2, 49.1.
HRMS (ESI): Calculated for $C_{15}H_{15}NO_2$ [M+H] = 242.1181; found = 242.1181.
Yield of product 68: 86%; 104.1 mg, 0.43 mmol.

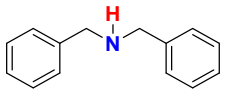


1H NMR (400 MHz, Chloroform-d) δ 7.64 (d, *J* = 7.6 Hz, 1H), 7.60 (d, *J* = 8.2 Hz, 1H), 7.47 (d, *J* = 7.4 Hz, 1H), 7.44 – 7.30 (m, 6H), 7.20 (t, *J* = 7.4 Hz, 1H), 6.85 (s, 1H), 6.69 (dd, *J* = 8.2, 2.0 Hz, 1H), 4.50 (bs, 1H), 4.41 (s, 2H), 3.82 (s, 2H).
^{13}C NMR (101 MHz, Chloroform-*d*) δ 147.3, 145.2, 142.2, 142.2, 139.1, 132.3, 128.7, 127.6, 127.3, 126.6, 124.9, 124.7, 120.6, 118.5, 112.3, 109.5, 48.8, 36.9.
HRMS (ESI): Calculated for $C_{20}H_{17}N$ [M+H] = 270.1283; found = 270.1284.

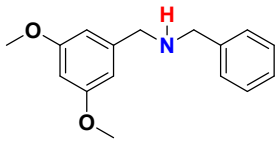
Yield of product 69: 84%; 113.4 mg, 0.42 mmol.



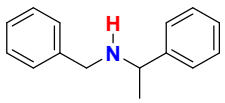
^{1}H NMR (300 MHz, Chloroform-*d*) δ 7.44 – 7.27 (m, 5H), 7.08 – 6.93 (m, 2H), 6.75 – 6.56 (m, 2H), 4.27 (s, 2H), 2.26 – 2.24 (m, 2H), 1.28 – 1.25 (m, 2H).
^{13}C NMR (75 MHz, Chloroform-*d*) δ 149.0, 138.4, 133.4, 129.8, 128.6, 127.9, 127.4, 114.3, 49.5, 29.7, 20.5.
HRMS (EI): Calculated for $C_{15}H_{17}NO$ = 228.0412; found = 228.0410.
Yield of product 70: 84%; 95.7 mg, 0.42 mmol.



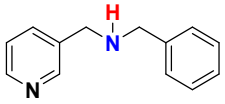
^{1}H NMR (300 MHz, Chloroform-*d*) δ 7.42- 7.24 (m, 10H), 3.82 (s, 4H), 1.61 (bs, 1H).
^{13}C NMR (101 MHz, Chloroform-d) δ 140.5, 128.5, 128.3, 127.1, 53.3.
HRMS (ESI): Calculated for $C_{14}H_{15}N$ [M+H] = 198.1283; found = 198.1288.
Yield of product 71: 81%; 80.2 mg, 0.405 mmol.



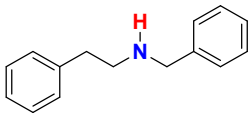
^{1}H NMR (300 MHz, Chloroform-*d*) δ 7.31 – 7.27 (m, 3H), 7.15 – 7.07 (m, 2H), 6.52 – 6.44 (d, *J* = 2.3, 2H), 6.27 – 6.20 (t, *J* = 2.3, 1H), 3.68 – 3.63 (m, 6H), 3.46 – 3.38 (m, 4H).
^{13}C NMR (75 MHz, Chloroform-*d*) δ 161.0, 160.7, 142.3, 139.5, 128.7, 128.6, 128.3, 128.2, 126.9, 106.6, 106.6, 98.7, 58.0, 57.9, 55.4, 55.3.
HRMS (ESI): Calculated for $C_{16}H_{19}NO_2$ = [M+H] 258.1494; found = 258.1496.
Yield of product 73: 79%; 101.9 mg, 0.395 mmol.



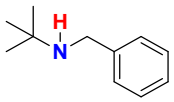
^{1}H NMR (300 MHz, Chloroform-d) δ 7.50 – 7.24 (m, 10H), 3.89 (q, *J* =1.1, 6.6, 1H), 3.79 – 3.63 (m, 2H), 1.61 (bs, 1H), 1.45 (dd, *J* =1.1, 6.7, 3H).
^{13}C NMR (75 MHz, Chloroform-d) δ 145.6, 140.7, 128.5, 128.4, 128.2, 127.0, 126.9, 126.7, 57.5, 51.7, 24.5.
HRMS (EI): Calculated for $C_{15}H_{17}N$ = 212.1078; found = 212.1076.
Yield of product 74: 75%; 79.5 mg, 0.375 mmol.



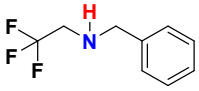
^{1}H NMR (300 MHz, Chloroform-*d*) δ 8.50 – 8.30 (m, 2H), 7.65 – 7.55 (dt, *J* =1.7, 7.8, 1H), 7.24 – 7.08 (m, 6H), 3.59 (s, 4H), 3.52 (bs, 1H).
^{13}C NMR (75 MHz, Chloroform-*d*) δ 149.6, 148.4, 139.1, 136.2, 135.0, 128.5, 128.3, 127.3, 123.5, 52.9, 50.0.
HRMS (ESI): Calculated for $C_{13}H_{14}N_2$ [M+H] = 199.1235; found = 199.1237.
Yield of product 75: 82%; 81.6 mg, 0.41 mmol.



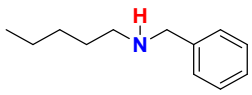
^{1}H NMR (300 MHz, Chloroform-*d*) δ 7.18 – 7.12 (m, 5H), 7.12 – 7.07 (m, 2H), 7.07 – 7.02 (m, 3H), 3.67 (s, 2H), 2.80 – 2.73 (m, 2H), 2.72 – 2.65 (m, 2H), 1.87 (bs, 1H).
^{13}C NMR (75 MHz, Chloroform-*d*) δ 139.9, 139.9, 128.7, 128.5, 128.4, 128.2, 127.0, 126.2, 53.8, 50.4, 36.2.
HRMS (ESI): Calculated for $C_{15}H_{17}N$ [M+H] = 212.1439; found = 212.1444.
Yield of product 76: 82%; 86.8 mg, 0.41 mmol.



^{1}H NMR (300 MHz, Chloroform-*d*) δ 7.39 – 7.17 (m, 5H), 3.68 (s, 2H), 1.26 (bs, 1H), 1.12 (s, 9H).
^{13}C NMR (75 MHz, Chloroform-*d*) δ 141.4, 128.4, 128.3, 126.8, 50.7, 47.3, 29.1.
HRMS (EI): Calculated for $C_{11}H_{17}N$ = 164.1439; found = 164.1437.



^{1}H NMR (300 MHz, Chloroform-*d*) δ 7.40 – 7.25 (m, 5H), 4.00 – 3.84 (d, *J* = 4.8, 2H), 3.31 – 3.06 (qd, *J* = 6.5, 9.4, 2H), 1.63 (bs, 1H).
^{13}C NMR (75 MHz, Chloroform-d) δ 139.1, 128.5, 128.0, 127.4, 125.6, 53.0, 49.5.
^{19}F NMR (376 MHz, Chloroform-d) δ -71.46.
HRMS (ESI): Calculated for $C_{10}H_{14}NF_3$ [M+H] = 206.0491; found = 206.0488.

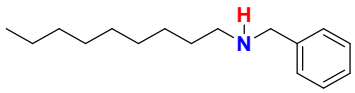


^{1}H NMR (300 MHz, Chloroform-*d*) δ 7.25 – 7.10 (m, 5H), 3.83 – 3.65 (m, 2H), 3.18 (bs, 1H), 2.51 – 2.50 (m, 2H), 1.42 – 1.07 (m, 6H), 0.82 – 0.77 (m, 3H).

^{13}C NMR (75 MHz, Chloroform-*d*) δ 139.0, 127.7, 127.4, 127.3, 127.0, 126.1, 57.2, 47.9, 28.4, 21.5, 12.9.

HRMS (ESI): Calculated for $C_{12}H_{19}N$ [M+H] 178.1595; found = 178.1591.

Yield of product 80: 82%; 73.0 mg, 0.41 mmol.

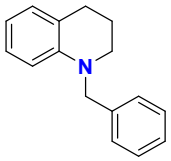


^{1}H NMR (300 MHz, Chloroform-*d*) δ 7.36 – 7.26 (m, 5H), 4.03 (bs, 1H), 3.80 – 3.61 (m, 2H), 2.73 – 2.39 (m, 2H), 1.64 – 1.51 (m, 2H), 1.37 – 1.18 (m, 12H), 0.92 – 0.88 (m, 3H).

^{13}C NMR (75 MHz, Chloroform-*d*) δ 137.6, 126.3, 126.1, 126.0, 125.6, 124.8, 50.9, 46.4, 29.4, 29.4, 27.0, 27.0, 26.8, 24.8, 20.2, 20.2, 11.6.

HRMS (ESI): Calculated for $C_{14}H_{23}N$ [M+H] = 206.1908; found = 206.1913.

Yield of product 81: 86%; 88.4 mg, 0.43 mmol.

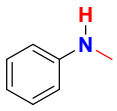


^{1}H NMR (400 MHz, Chloroform-d) δ 7.24 – 7.12 (m, 5H), 6.90 – 6.83 (m, 2H), 6.50 – 6.39 (m, 2H), 4.38 (s, 2H), 3.27 (td, *J* = 5.3, 1.9 Hz, 2H), 2.72 (t, *J* = 6.3 Hz, 2H), 1.92 (dtdd, *J* = 7.0, 5.9, 4.2, 1.1 Hz, 2H).

^{13}C NMR (101 MHz, Chloroform-d) δ 145.69, 139.03, 129.08, 128.65, 127.26, 126.83, 126.66, 122.29, 115.92, 111.04, 55.26, 49.97, 28.31, 22.46.

HRMS (ESI): Calculated for $C_{17}H_{17}N$ [M+H] = 224.1439; found = 224.1443.

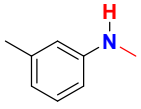
Yield of product 82: 80%; 89.5 mg, 0.40 mmol.



^{1}H NMR (300 MHz, Chloroform-*d*) δ 7.25 – 7.04 (m, 2H), 6.73 – 6.45 (m, 3H), 3.71 (bs, 1H), 2.72 (s, 3H).

^{13}C NMR (75 MHz, Chloroform-*d*) δ 149.3, 129.2, 117.3, 112.4, 30.7.

HRMS (EI): Calculated for $C_{7}H_{9}N$ =108.1412; found =108.1410.

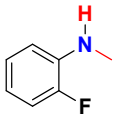


^{1}H NMR (300 MHz, Chloroform-d) δ 7.21 – 7.05 (dq, *J* =4.3, 5.8, 8.7, 1H), 6.76 – 6.33 (dt, *J* =4.1, 33.3, 3H), 3.60 (bs, 1H), 2.88 (s, 3H), 2.38 (s, 3H).

^{13}C NMR (75 MHz, Chloroform-d) δ 149.4, 139.0, 129.1, 118.2, 113.2, 109.7, 30.8, 21.6.

HRMS (EI): Calculated for $C_{8}H_{11}N$ = 122.0914; found =122.0912.

Yield of product 86: 61%; 37.2 mg, 0.305 mmol.



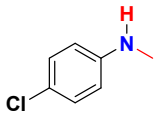
^{1}H NMR (400 MHz, DMSO-d_6) δ 7.15 – 6.86 (m, 2H), 6.74 – 6.46 (m, 2H), 5.53 (bs, 1H), 2.81 – 2.65 (m, 3H).

^{13}C NMR (101 MHz, DMSO-d_6) δ 151.3 (d, J = 237.4 Hz), 138.4 (d, J = 11.8 Hz), 125.2 (d, J = 3.5 Hz), 115.4 (d, J = 6.7 Hz), 114.4 (d, J = 17.9 Hz), 111.6 (d, J = 4.1 Hz), 29.9.

^{19}F NMR (376 MHz, DMSO-d6) δ -135.65.

HRMS (EI): Calculated for C_7H_8NF = 126.0615; found = 126.0613.

Yield of product 87: 56%; 35.2 mg, 0.28 mmol.

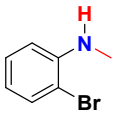


^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.16 – 7.11 (m, 2H), 6.55 – 6.50 (m, 2H), 3.68 (bs, 1H), 2.81 (s, 3H).

^{13}C NMR (101 MHz, Chloroform-d) δ 147.8, 129.0, 121.8, 113.4, 30.8.

HRMS: Calculated for C_7H_8NCl [M+H] = 142.0423; found = 142.0424.

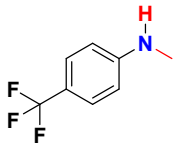
Yield of product 88: 41%; 29.1 mg, 0.205 mmol.



^{1}H NMR (300 MHz, Chloroform-d) δ 7.51 – 7.41 (m, 1H), 7.29 – 7.17 (s, 1H), 6.73 – 6.56 (m, 2H), 4.36 (bs, 1H), 2.91 (s, 3H).

^{13}C NMR (75 MHz, Chloroform-d) δ 145.9, 132.3, 128.5, 117.6, 110.8, 109.6, 30.6.

HRMS (EI): Calculated for C_7H_8NBr = 184.9834; found = 184.9828.



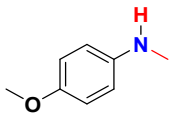
^{1}H NMR (300 MHz, Chloroform-*d*) δ 7.46 – 7.38 (m, 2H), 6.64 – 6.57 (m, 2H), 4.06 (bs, 1H), 2.87 (s, 3H).

^{13}C NMR (75 MHz, Chloroform-*d*) δ 151.6, 126.8, 126.64, 126.5, 126.5, 126.4, 123.2, 118.8, 118.4, 111.4, 30.2.

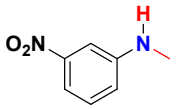
^{19}F NMR (376 MHz, Chloroform-d) δ -60.92.

HRMS (EI): Calculated for $C_8H_8NF_3$ = 176.0114; found = 176.0112.

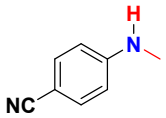
Yield of product 90: 57%; 50.1 mg, 0.285 mmol.



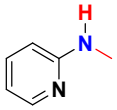
^{1}H NMR (300 MHz, Chloroform-*d*) δ 6.84 – 6.77 (m, 2H), 6.63 – 6.57 (m, 2H), 3.76 (s, 3H), 3.42 (bs, 1H), 2.82 (s, 3H).
^{13}C NMR (75 MHz, Chloroform-*d*) δ 152.1, 143.6, 114.9, 113.7, 55.8, 31.6.
HRMS (EI): Calculated for $C_8H_{11}NO$ = 137.0835; found = 137.0832.
Yield of product 91: 60%; 41.1 mg, 0.30 mmol.



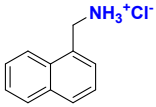
^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.52 (ddd, *J* = 8.1, 2.2, 0.9 Hz, 1H), 7.27 (t, *J* = 8.1 Hz, 1H), 6.87 (ddd, *J* = 8.2, 2.4, 0.9 Hz, 1H), 4.17 (s, 1H), 2.90 (s, 3H).
^{13}C NMR (101 MHz, Chloroform-*d*) δ 149.9, 149.4, 129.6, 118.5, 111.8, 105.8, 30.5.
HRMS (EI): Calculated for $C_7H_8N_2O_2$ = 153.0217; found = 153.0214.



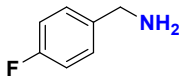
^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.46 – 7.30 (m, 2H), 6.60 – 6.36 (m, 2H), 4.24 (bs, 1H), 2.76 (s, 3H).
^{13}C NMR (101 MHz, Chloroform-*d*) δ 152.1, 133.6, 120.5, 111.9, 98.6, 30.0.
HRMS (EI): Calculated for $C_8H_8N_2$ = 132.0603; found = 132.0601.



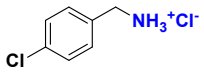
^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.25 – 7.70 (dq, *J* =2.1, 4.6, 1H), 7.48 – 7.14 (s, 1H), 6.56 – 6.12 (m, 2H), 5.08 (bs, 1H), 2.97 – 2.59 (m, 3H).
^{13}C NMR (101 MHz, Chloroform-*d*) δ 159.7, 147.9, 137.3, 112.4, 106.2, 28.9.
HRMS (ESI): Calculated for $C_6H_8N_2$ [M+H] = 109.0765; found = 109.0768.
Yield of product 94: 60%; 32.7 mg, 0.30 mmol.



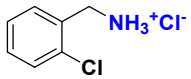
^{1}H NMR (300 MHz, DMSO-d_6) δ 9.97 – 8.20 (m, 3H), 8.18 – 8.14 (m, 1H), 8.02 – 7.96 (m, 2H), 7.72 – 7.69 (dd, *J* =1.2, 7.1, 1H), 7.63 – 7.5 (m, 3H), 4.49 (s, 2H).
^{13}C NMR (75 MHz, DMSO-d_6) δ 133.6, 131.1, 130.9, 129.3, 129.0, 127.5, 127.1, 126.6, 125.8, 123.9, 39.7.
Yield of product 97: 59%; 113.8 mg.



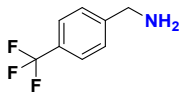
^{1}H NMR (400 MHz, DMSO-d_6) δ 7.45 – 7.22 (dd, J = 5.6, 8.3, 2H), 7.20 – 6.99 (m, 2H), 3.71 (s, 2H), 1.78 (bs, 2H).
^{13}C NMR (101 MHz, DMSO-d_6) δ 161.3 (d, J = 241.0 Hz), 140.9 (d, J = 3.0 Hz), 129.2 (d, J = 7.9 Hz), 115.1 (d, J = 21.0 Hz), 45.3.
^{19}F NMR (376 MHz, DMSO-d6) δ -117.32.
Yield of product 98: 62%; 77.5 mg.



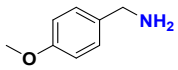
^{1}H NMR (400 MHz, DMSO-d_6) δ 8.66 (s, 3H), 7.49 (d, J = 7.8 Hz, 2H), 7.37 (d, J = 7.5 Hz, 2H), 3.91 (s, 2H).
^{13}C NMR (101 MHz, DMSO-d_6) δ 131.6, 131.5, 129.5, 126.9, 39.9.
Yield of product 99: 69%; 122.1 mg.



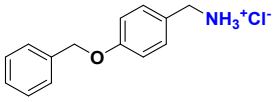
^{1}H NMR (400 MHz, DMSO-d_6) δ 9.03 – 8.68 (s, 3H), 7.68 – 7.63 (m, 1H), 7.49 – 7.45 (m, 1H), 7.39 – 7.34 (m, 2H), 4.05 (s, 2H).
^{13}C NMR (101 MHz, DMSO-d_6) δ 131.9, 130.7, 129.7, 129.3, 128.5, 126.5, 38.4.
Yield of product 100: 65%; 114.7 mg.



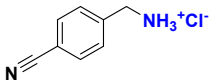
^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.56 (d, J = 8.1, 2H), 7.40 (d, J = 8.3, 2H), 3.84 (s, 2H), 1.51 (bs, 2H).
^{13}C NMR (101 MHz, Chloroform-*d*) δ 147.1, 129.0 (q, J = 32.2 Hz), 127.2, 125.3 (q, J = 3.9 Hz), 124.2 (q, J = 273.71 Hz), 45.9.
^{19}F NMR (376 MHz, Chloroform-d) δ -62.39.
Yield of product 101: 60%; 105 mg.



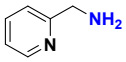
^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.28 – 7.20 (t, J = 7.8, 1H), 6.91 – 6.84 (m, 2H), 6.80 – 6.75 (ddd, J = 1.0, 2.6, 8.3, 1H), 3.83 (s, 2H), 3.80 (s, 3H), 1.56 (bs, 2H).
^{13}C NMR (101 MHz, Chloroform-*d*) δ 145.0, 129.6, 119.3, 112.2, 55.2, 46.4.
Yield of product 102: 72%; 98.6 mg.



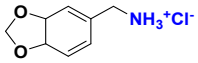
^{1}H NMR (400 MHz, DMSO-d_6) δ 8.65 (s, 3H), 7.41 – 7.32 (m, 5H), 7.32 – 7.27 (d, J = 7.5, 2H), 6.99 – 6.90 (d, J = 8.0, 2H), 5.03 (s, 2H), 3.76 (s, 2H).
^{13}C NMR (101 MHz, DMSO-d_6) δ 158.6, 137.3, 131.0, 128.8, 128.2, 128.0, 126.6, 115.2, 69.6, 42.0.
Yield of product 104: 60%; 149.1 mg.



^{1}H NMR (300 MHz, DMSO-d_6) δ 8.80 (s, 3H), 7.97 – 7.88 (dd, J = 1.5, 8.3, 2H), 7.79 – 7.70 (dd, J = 1.6, 8.3, 2H), 4.11 (s, 2H).
^{13}C NMR (75 MHz, DMSO-d_6) δ 140.1, 132.8, 130.3, 119.0, 111.5, 42.0.
Yield of product 105: 31%; 52.1 mg.

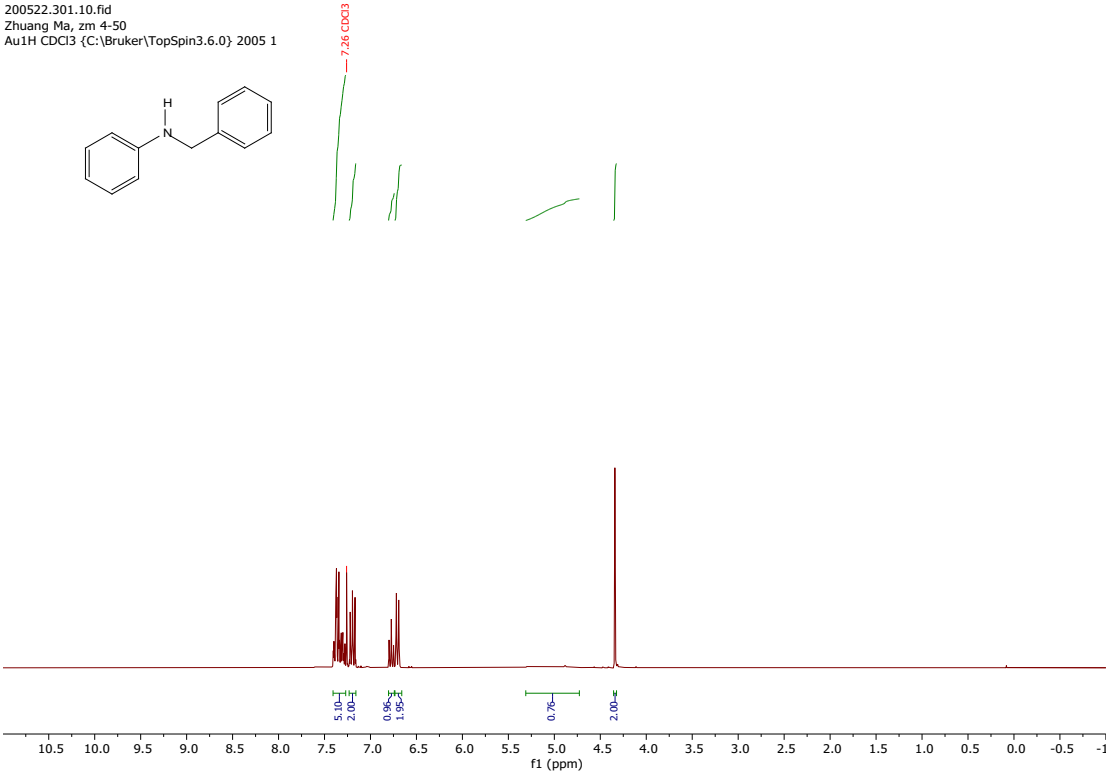


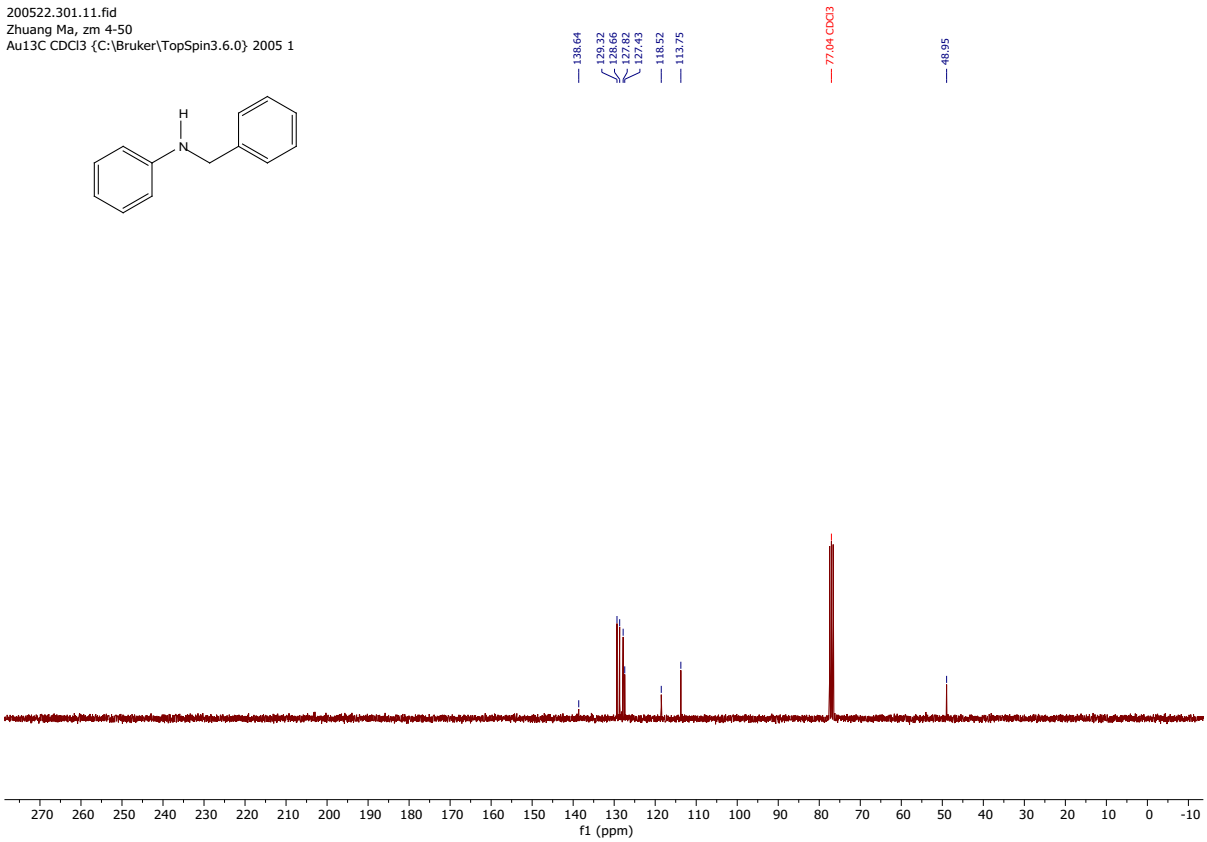
^{1}H NMR (300 MHz, Chloroform-d) δ 8.35 – 8.19 (dtd, J = 1.5, 3.0, 4.9, 1H), 7.44 – 7.28 (tdd, J = 1.7, 3.4, 7.3, 1H), 7.06 – 6.96 (dt, J = 2.5, 8.1, 1H), 6.92 – 6.80 (m, 1H), 3.71 – 3.66 (m, 2H), 1.60 (bs, 2H).
^{13}C NMR (75 MHz, Chloroform-d) δ 161.8, 149.0, 136.2, 121.5, 120.9, 47.6.
Yield of product 106: 70%; 75.6 mg.



^{1}H NMR (400 MHz, DMSO-d_6) δ 8.83 (s, 3H), 7.28 – 7.08 (d, J = 3.9, 1H), 7.06 – 6.81 (m, 2H), 6.09 – 5.90 (s, 2H), 4.07 – 3.77 (m, 2H).
^{13}C NMR (101 MHz, DMSO-d_6) δ 147.6, 128.1, 123.3, 110.0, 108.6, 101.6, 42.3.
Yield of product 108: 62%; 117.1 mg.

S7. NMR spectra





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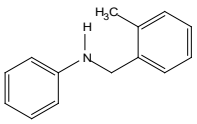

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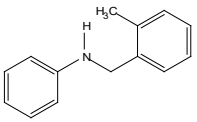

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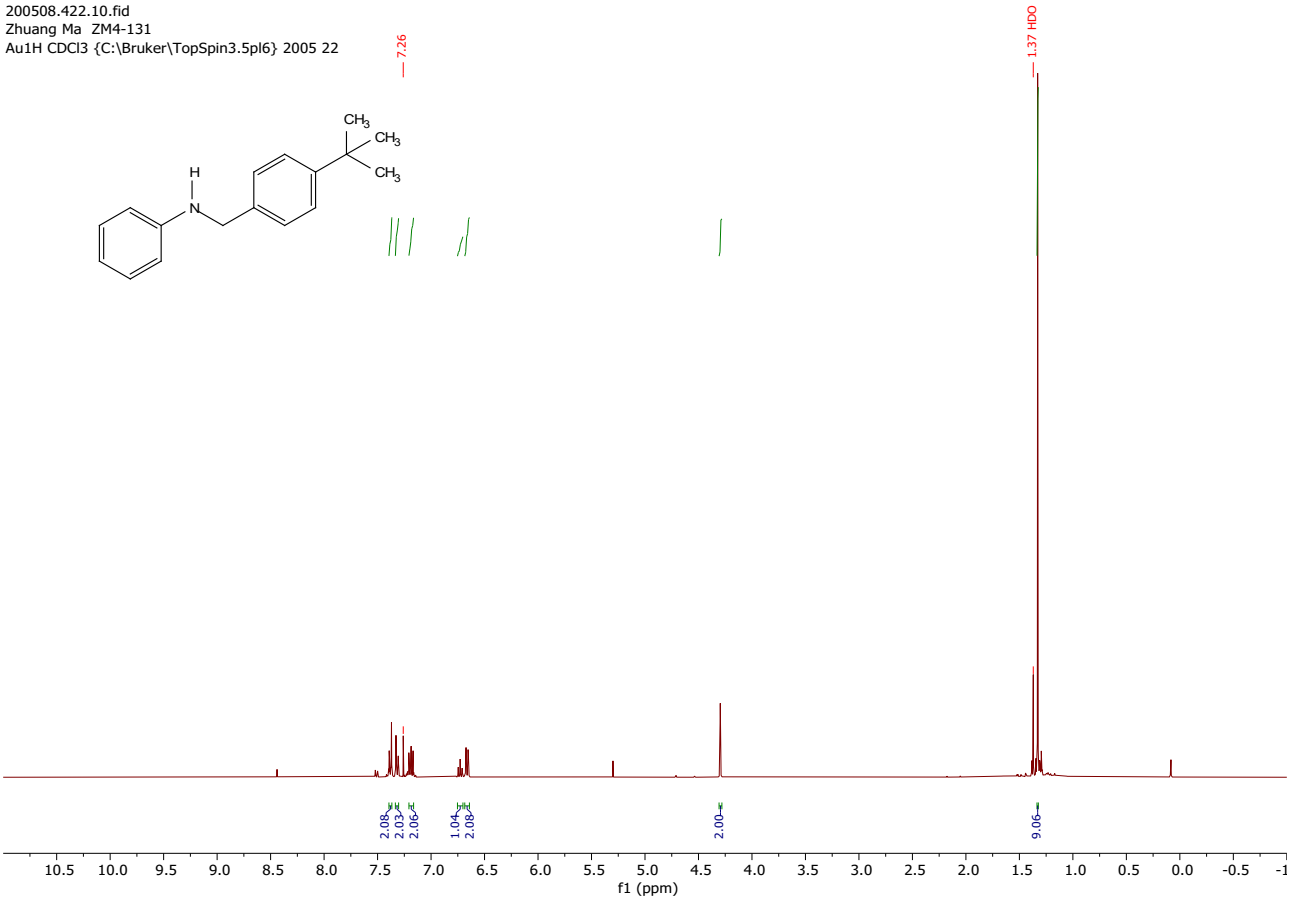

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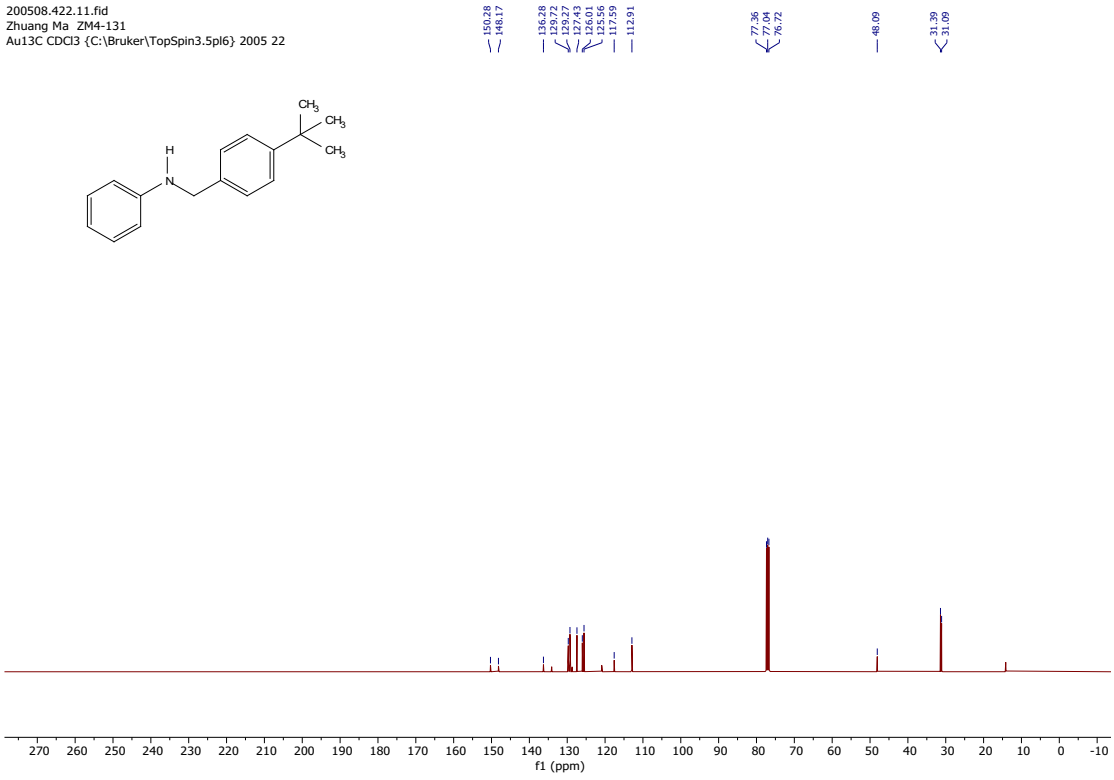

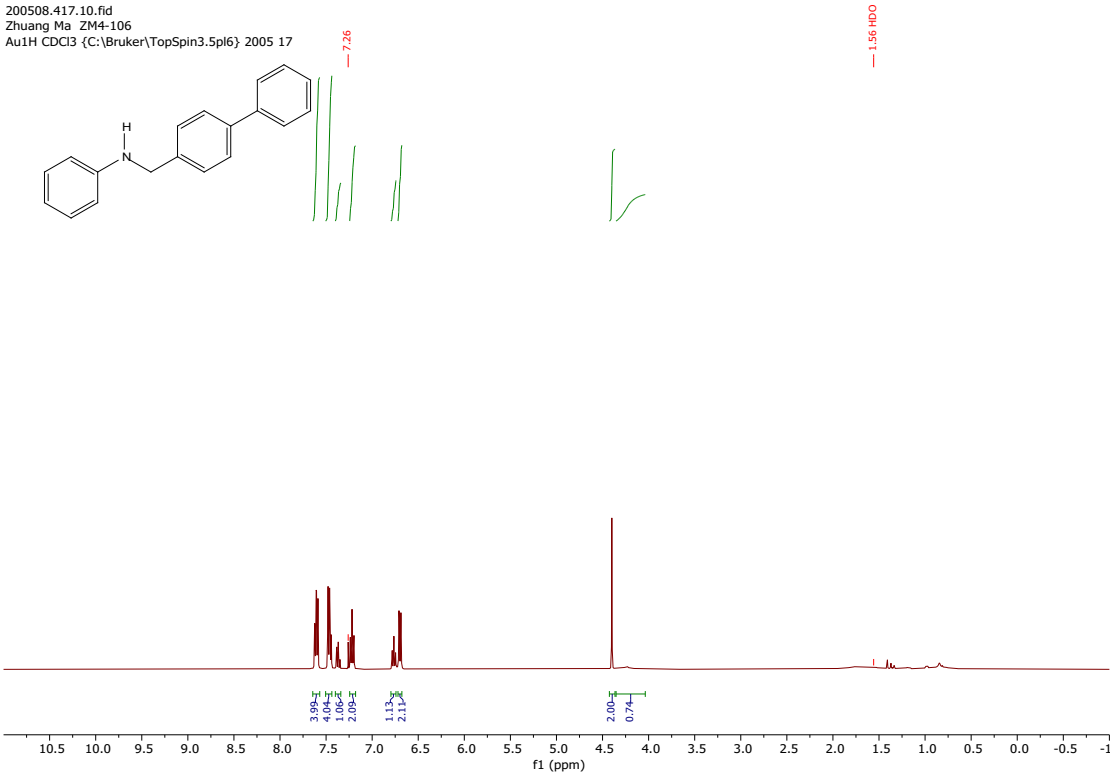
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2.11
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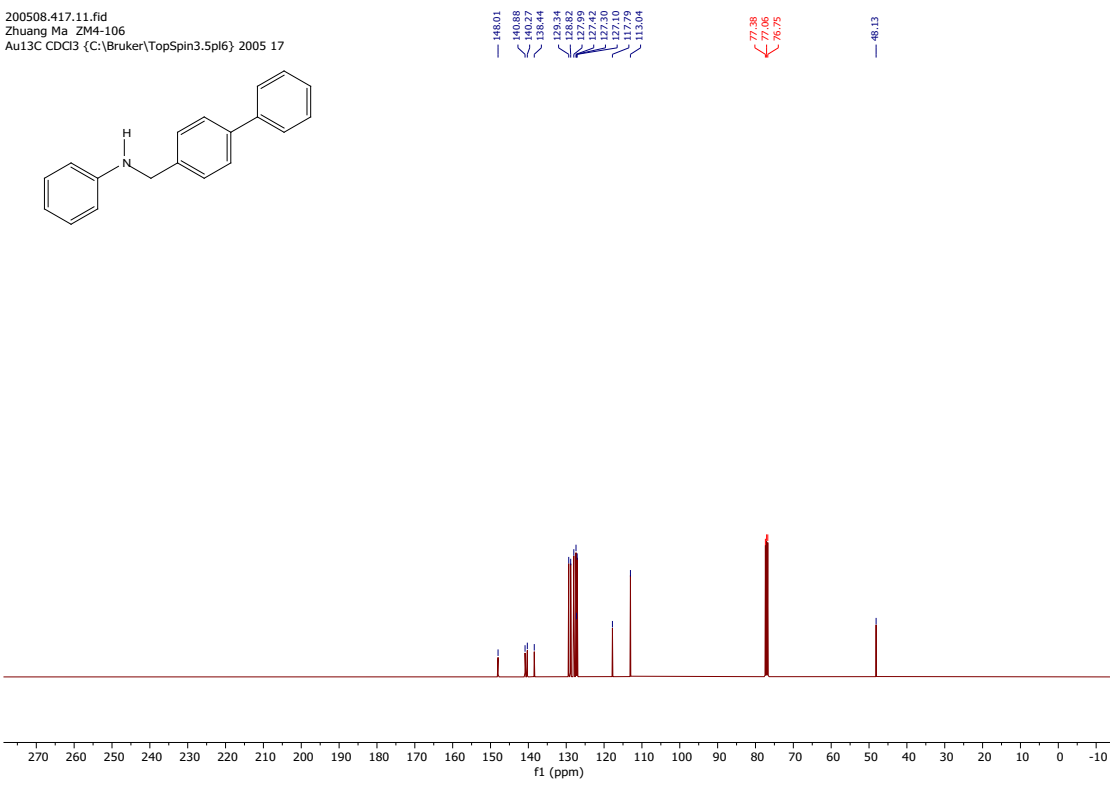
f1 (ppm)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Zhuang Ma ZM4-106
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H
N
270 260 250 240 230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
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200619.f311.10.fid
Zhuang Ma ZM4-100
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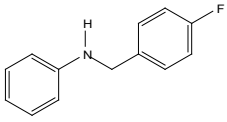

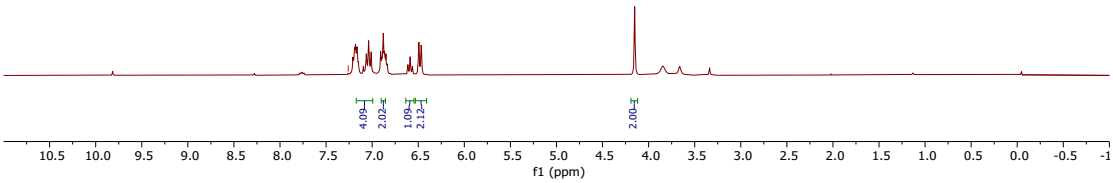

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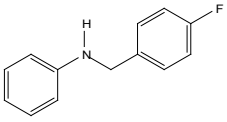

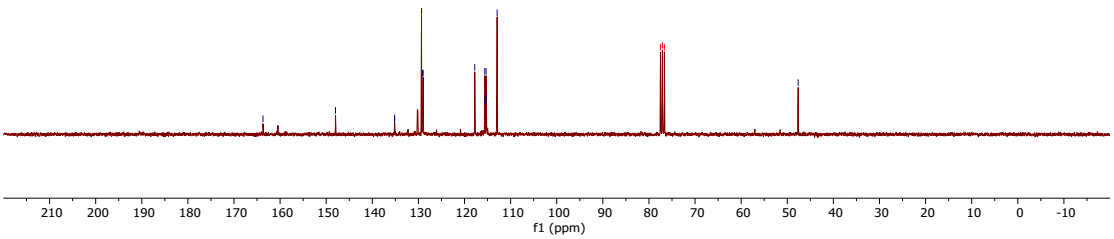

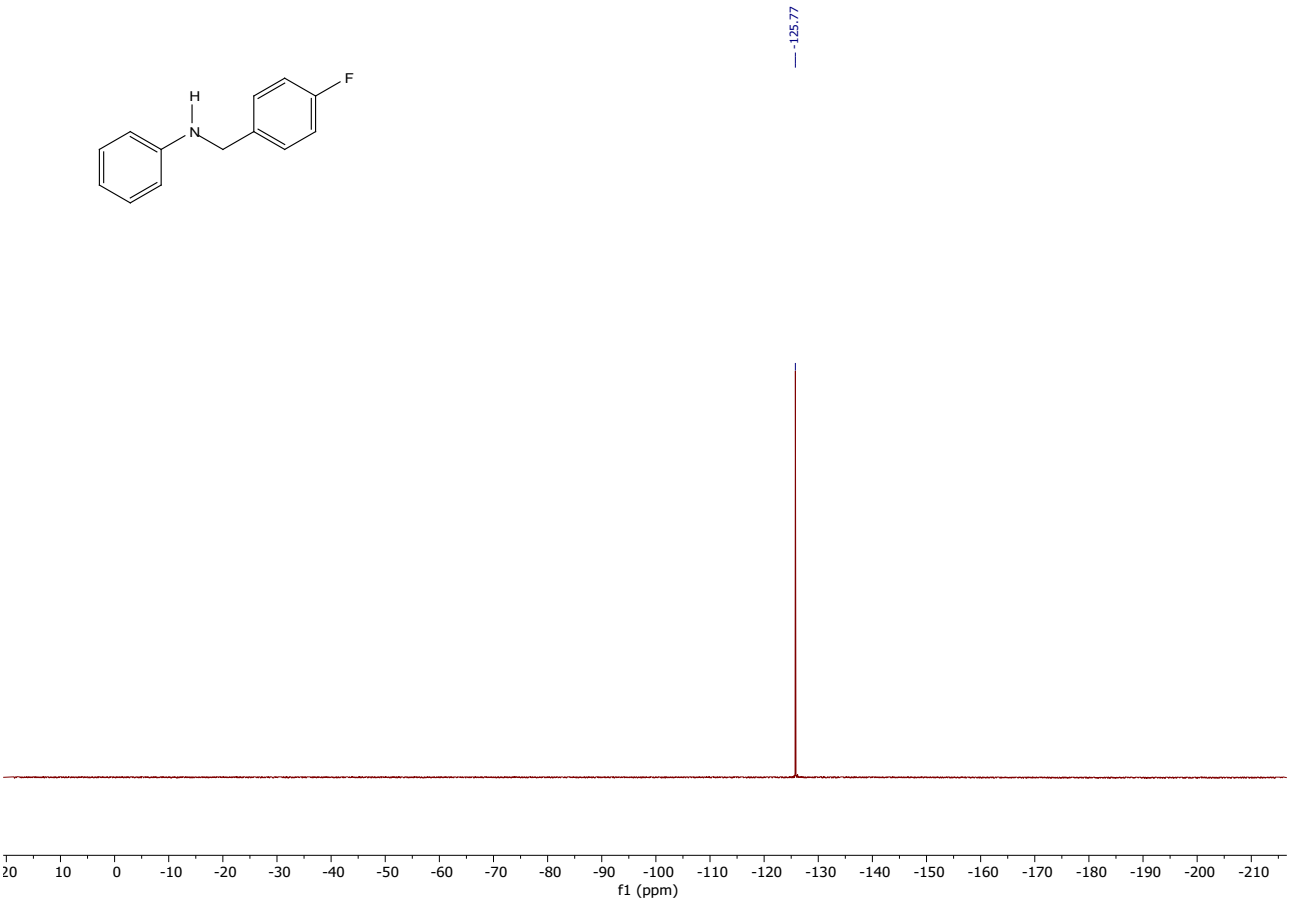
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N
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f1 (ppm)

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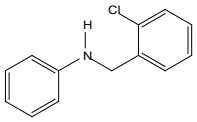

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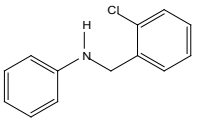
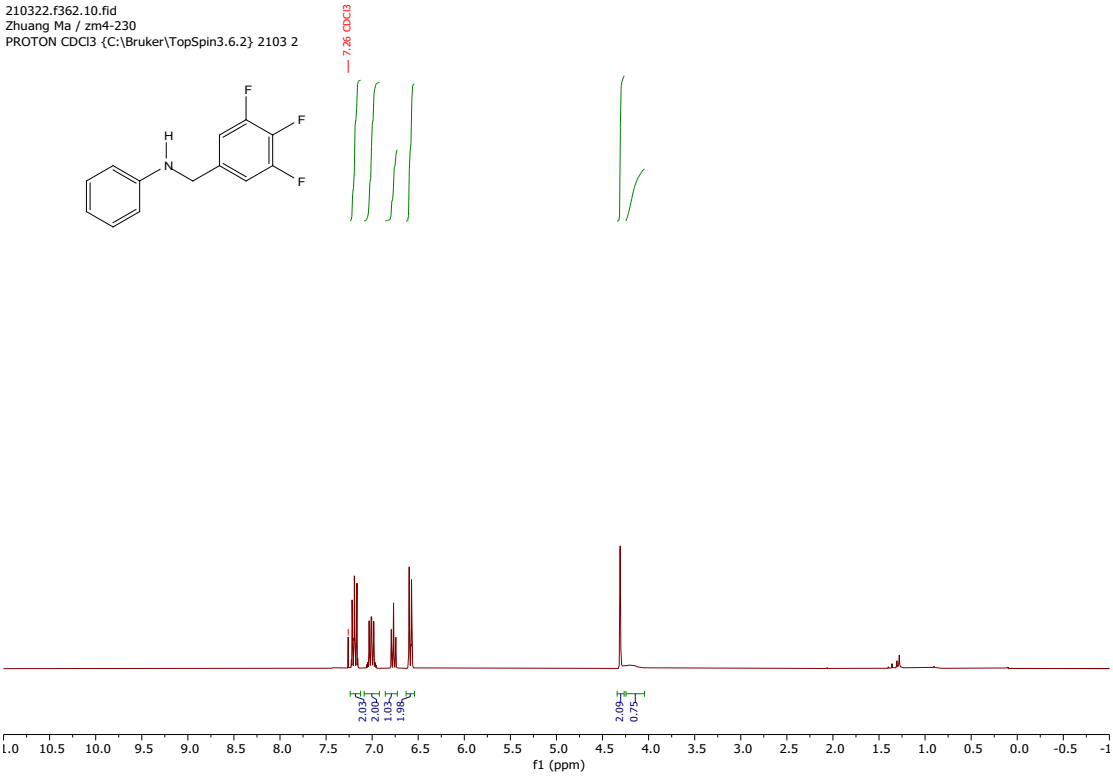
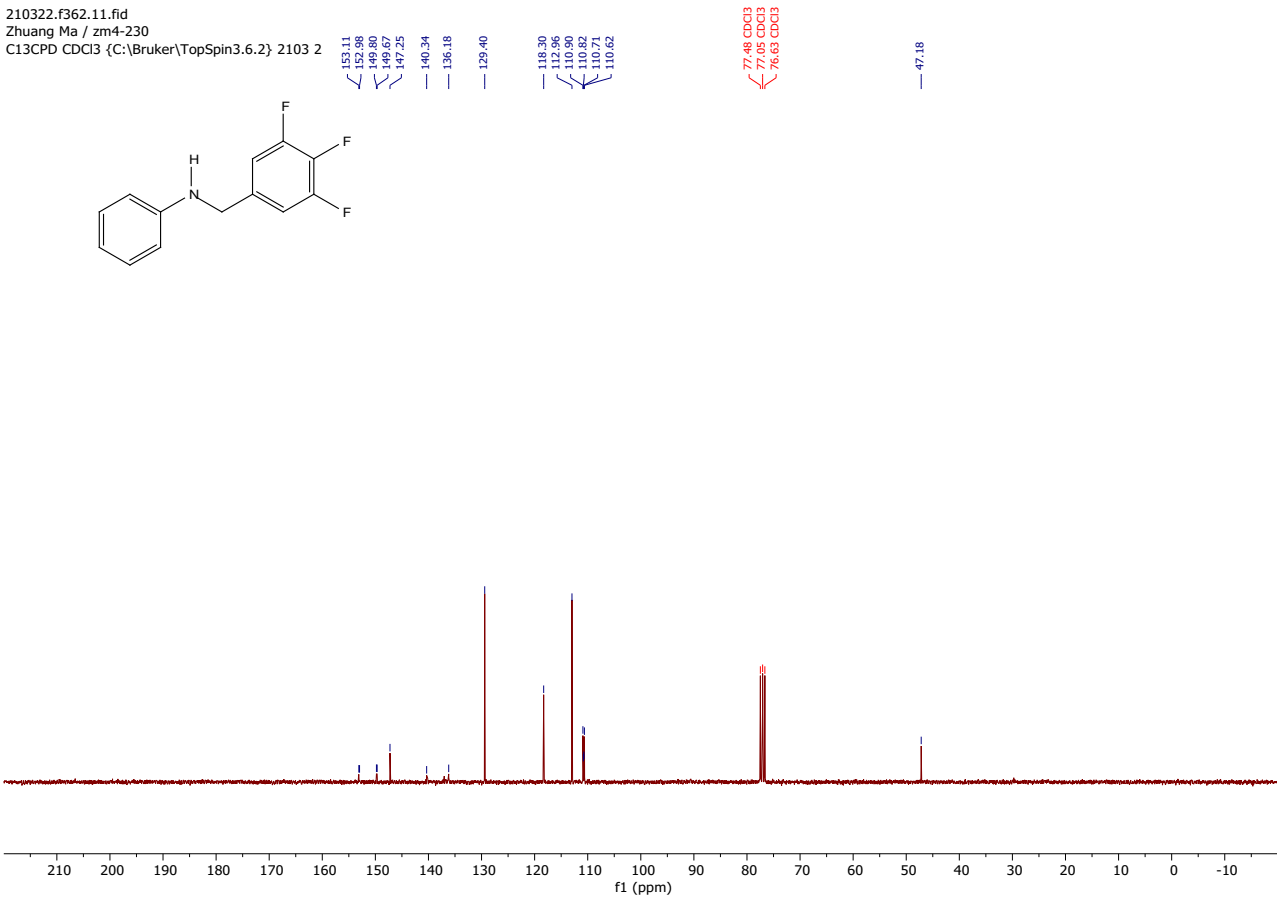
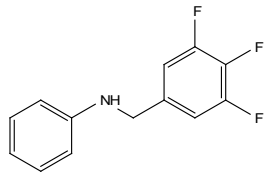
Au13C CDCl3 {C:\Bruker\TopSpin3.5pl6} 2104 9



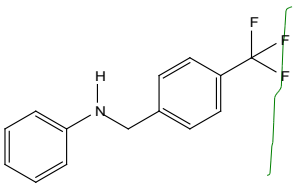

210322.f362.10.fid
Zhuang Ma / zm4-230
PROTON CDCl3 {C:\Bruker\TopSpin3.6.2} 2103 2
7.26 CDCl3
F
F
F
H
N
2.03
2.00
1.03
1.98
2.09
0.75
f1 (ppm)


210322.f362.11.fid
Zhuang Ma / zm4-230
C13CPD CDCl3 {C:\Bruker\TopSpin3.6.2} 2103 2
153.11
152.98
149.80
149.67
147.25
140.34
136.18
129.40
118.30
112.96
110.90
110.82
110.71
110.62
77.48 CDCl3
77.05 CDCl3
76.63 CDCl3
47.18
F
F
F
H
N
f1 (ppm)

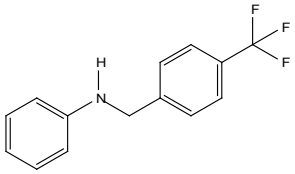
211115.312.10.fid
Zhuang Ma ZM 4-230
Au19F CDCl3 {C:\Bruker\TopSpin3.6.2} 2111 12



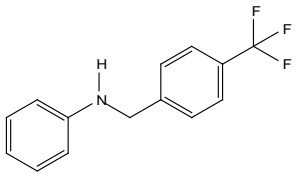
210617.318.10.fid
Zhuang Ma ZM4-460
Au1H CDCl3 {C:\Bruker\TopSpin3.6.2} 2106 18



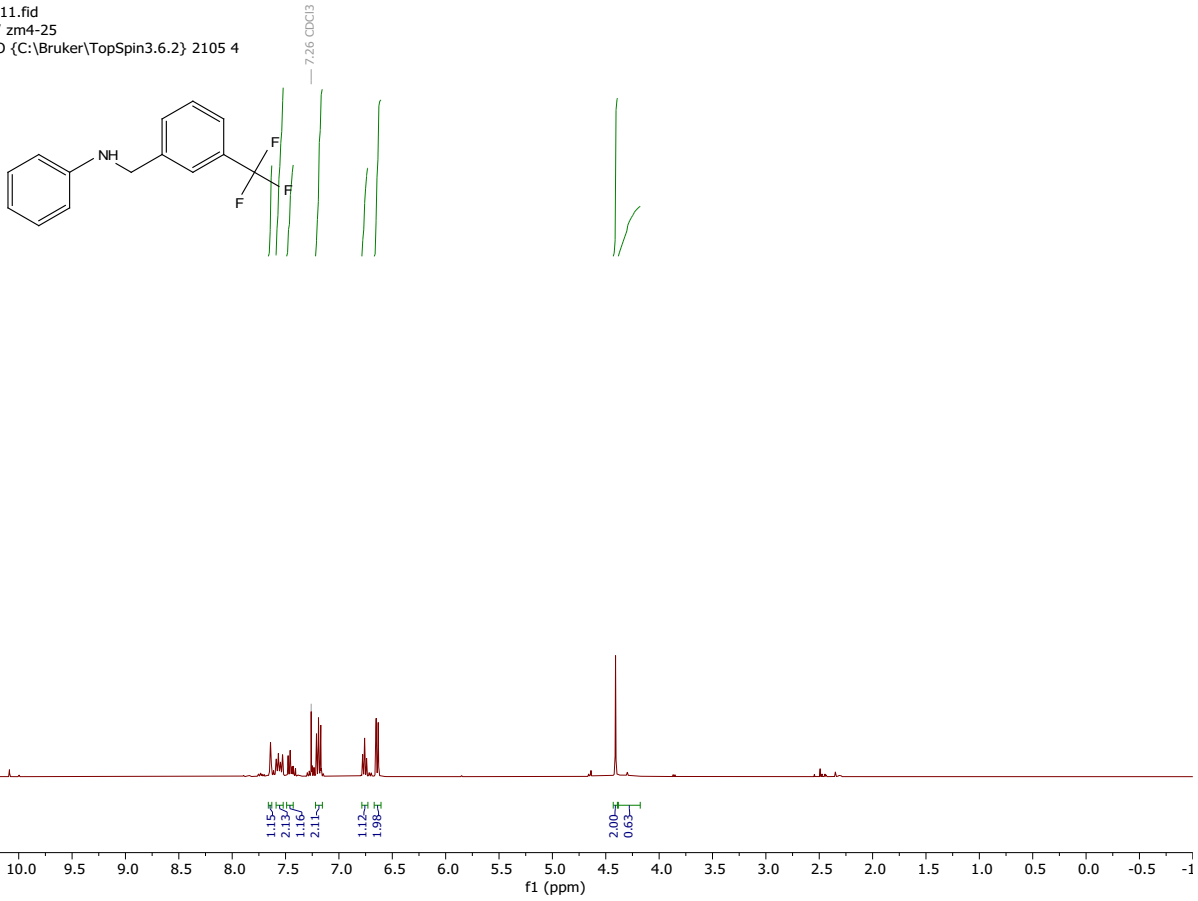
210617.318.11.fid
Zhuang Ma ZM4-460
Au13C CDCl3 {C:\Bruker\TopSpin3.6.2} 2106 18



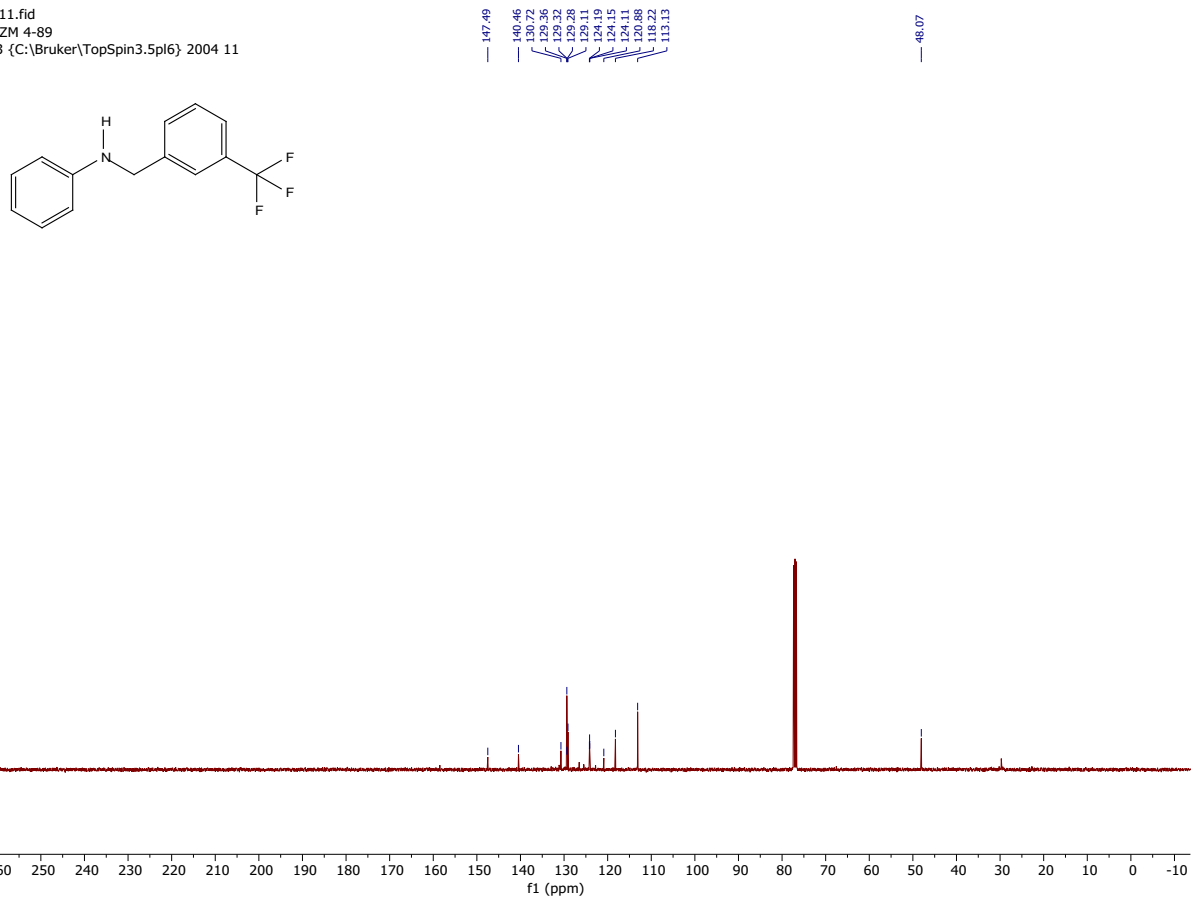
211115.314.10.fid
Zhuang Ma ZM 4-460
Au19F CDCl3 {C:\Bruker\TopSpin3.6.2} 2111 14



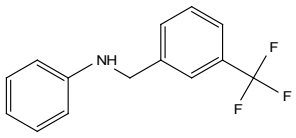
210512.304.11.fid
Zhuang Ma / zm4-25
Au13C DMSO {C:\Bruker\TopSpin3.6.2} 2105 4



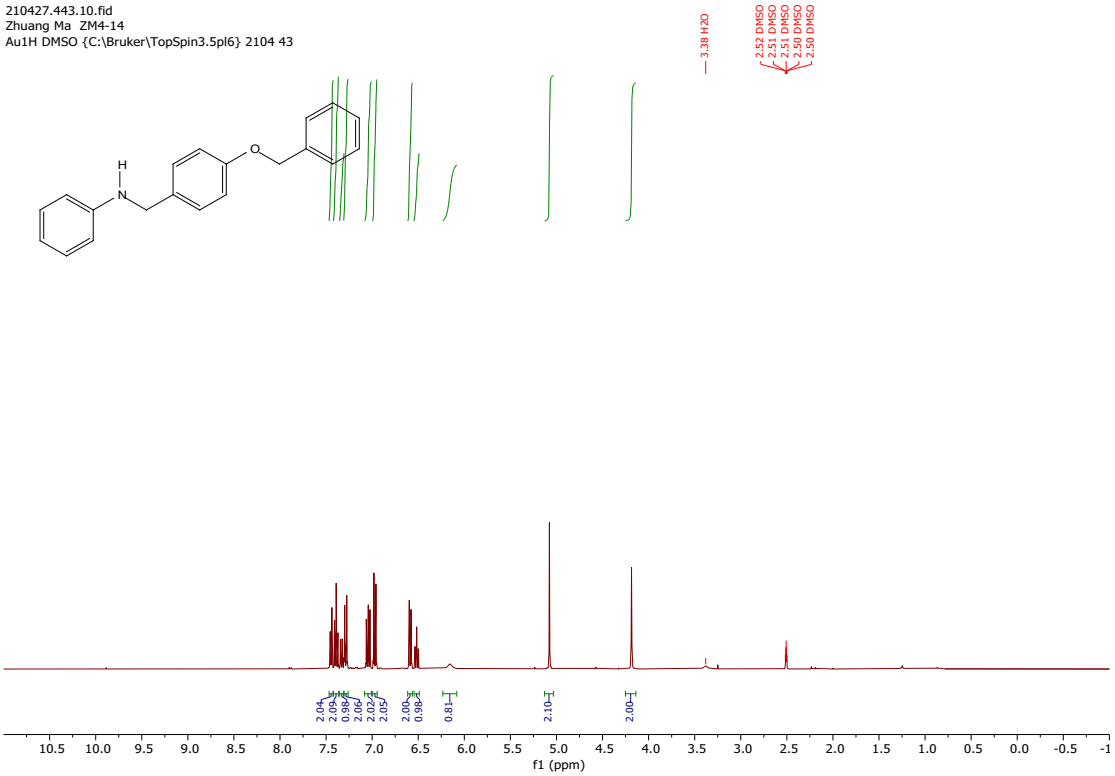
200427.411.11.fid
Zhuang Ma ZM 4-89
Au13C CDCl3 {C:\Bruker\TopSpin3.5pl6} 2004 11



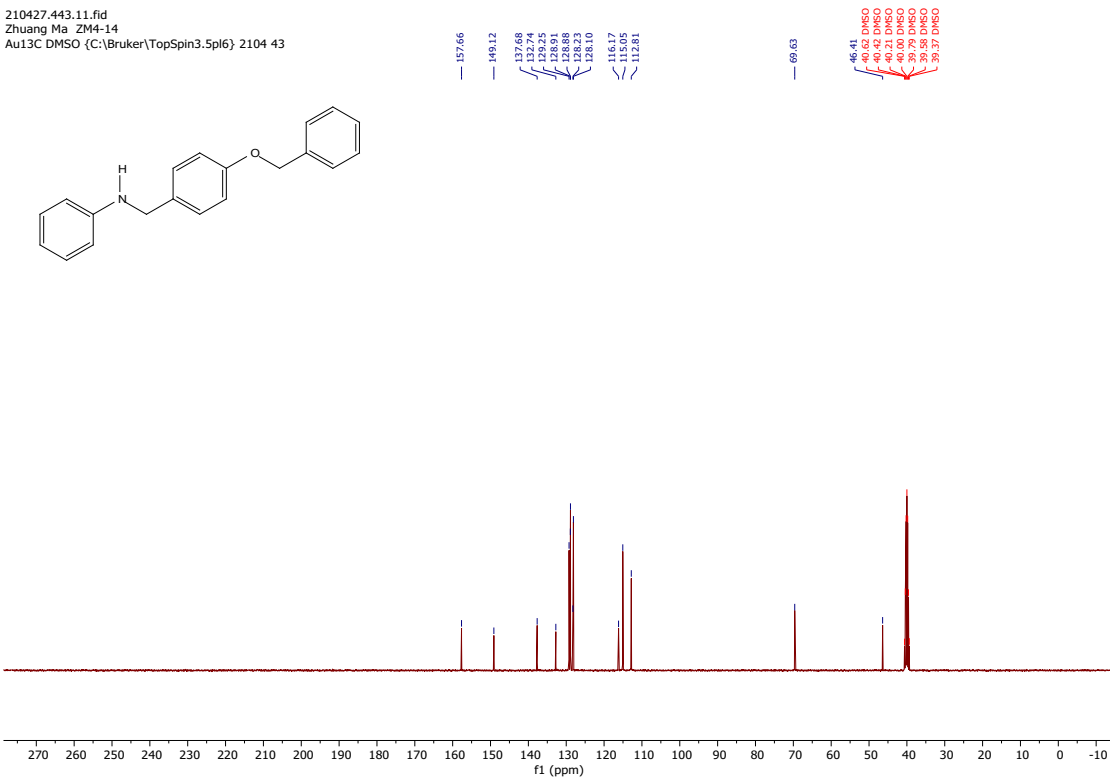
211115.311.10.fid
Zhuang Ma ZM 4-89
Au19F CDCl3 {C:\Bruker\TopSpin3.6.2} 2111 11



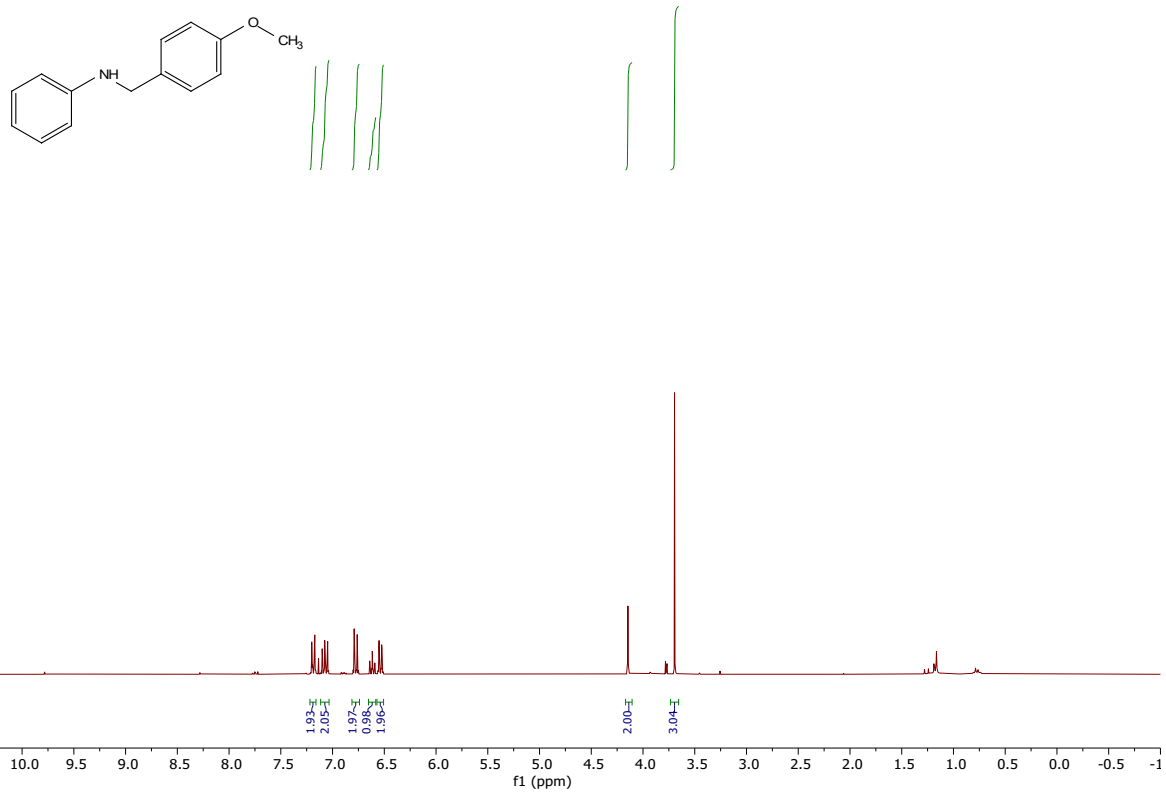
210427.443.10.fid
Zhuang Ma ZM4-14
Au1H DMSO {C:\Bruker\TopSpin3.5pl6} 2104 43



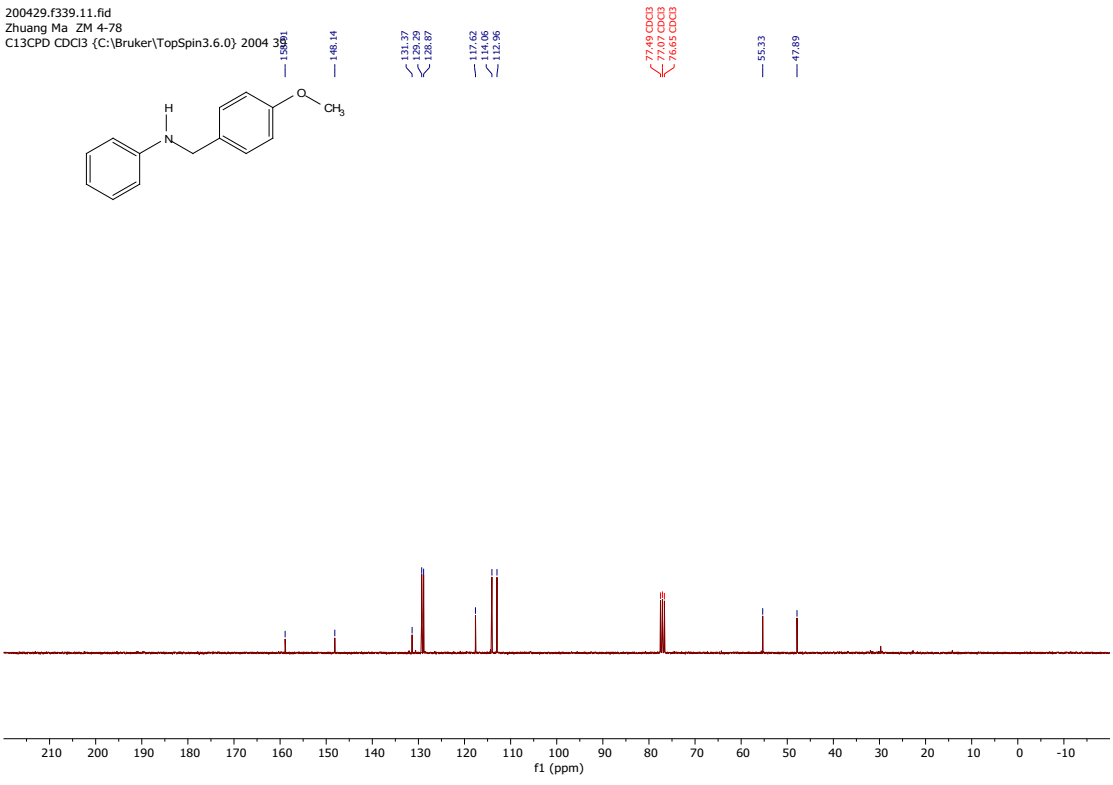
210427.443.11.fid
Zhuang Ma ZM4-14
Au13C DMSO {C:\Bruker\TopSpin3.5pl6} 2104 43



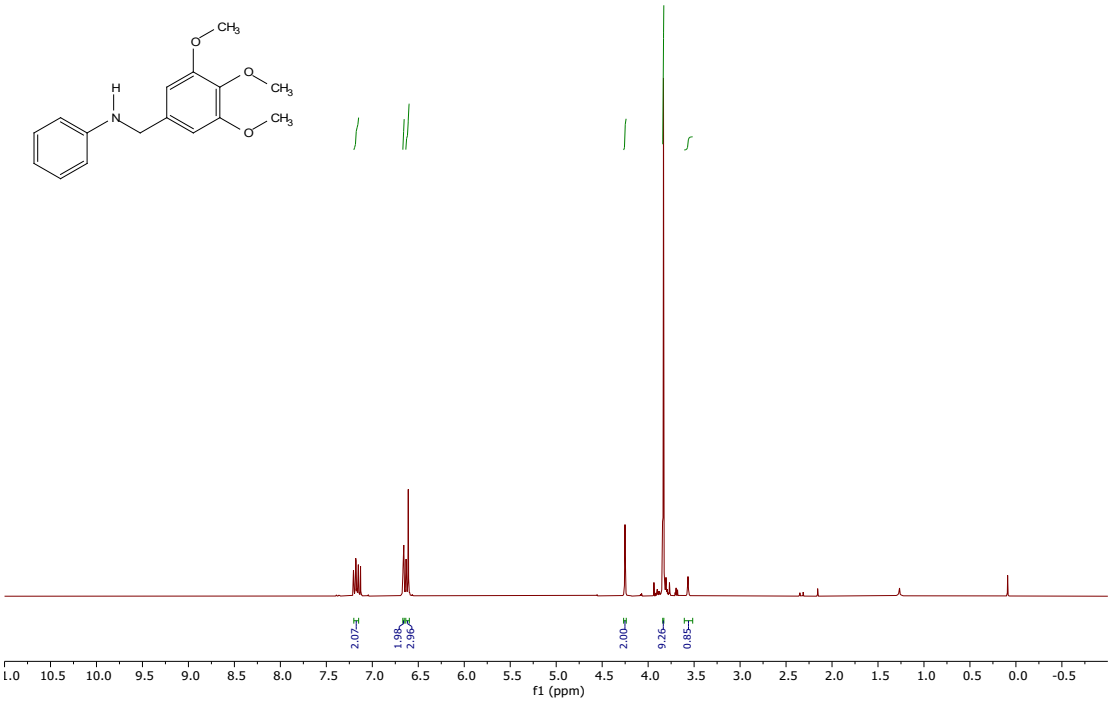
200429.f339.10.fid
Zhuang Ma ZM 4-78
PROTON CDCl3 {C:\Bruker\TopSpin3.6.0} 2004 39



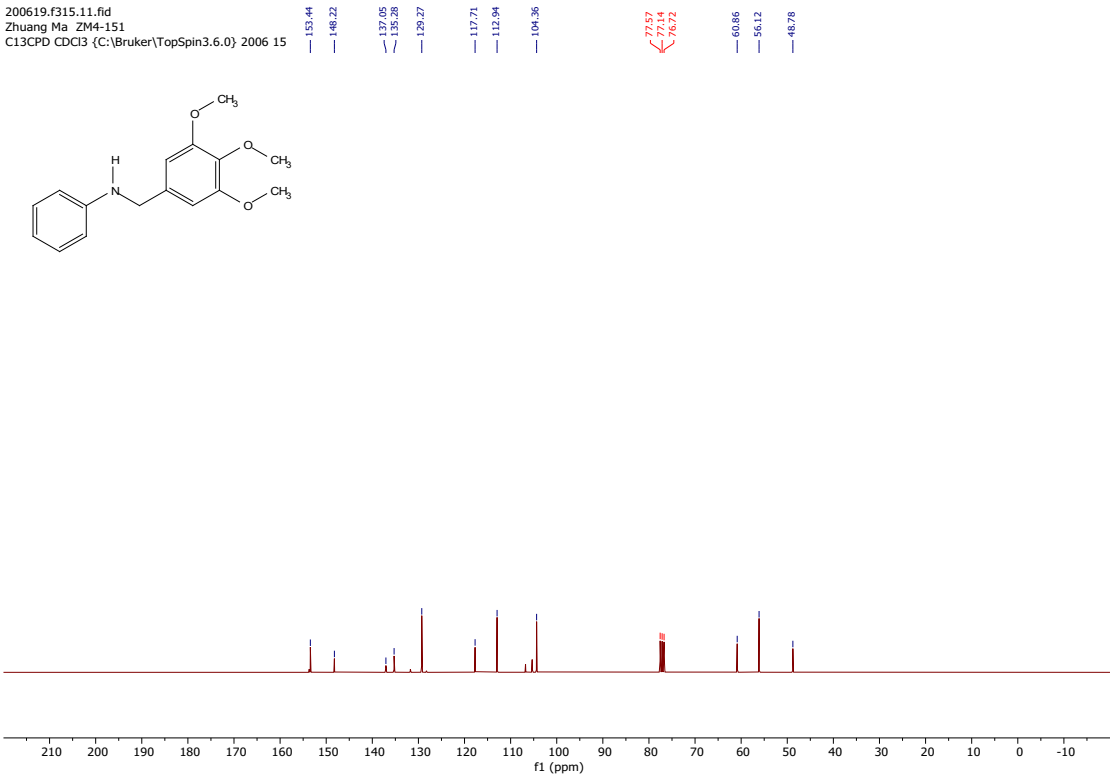
200429.f339.11.fid
Zhuang Ma ZM 4-78
C13CPD CDCl3 {C:\Bruker\TopSpin3.6.0} 2004 3



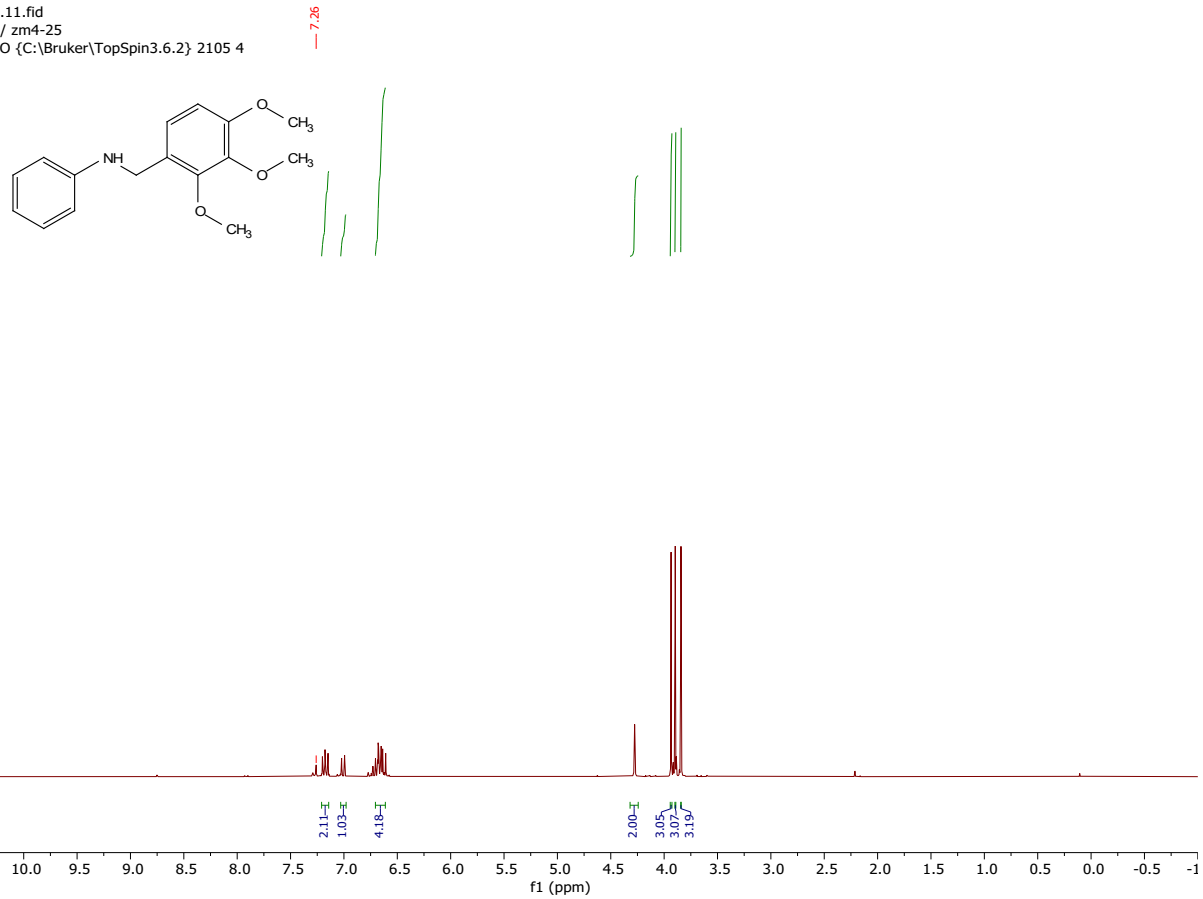
200619.f315.11.fid
Zhuang Ma ZM4-151
H1CPD CDCl3 {C:\Bruker\TopSpin3.6.0} 2006 15



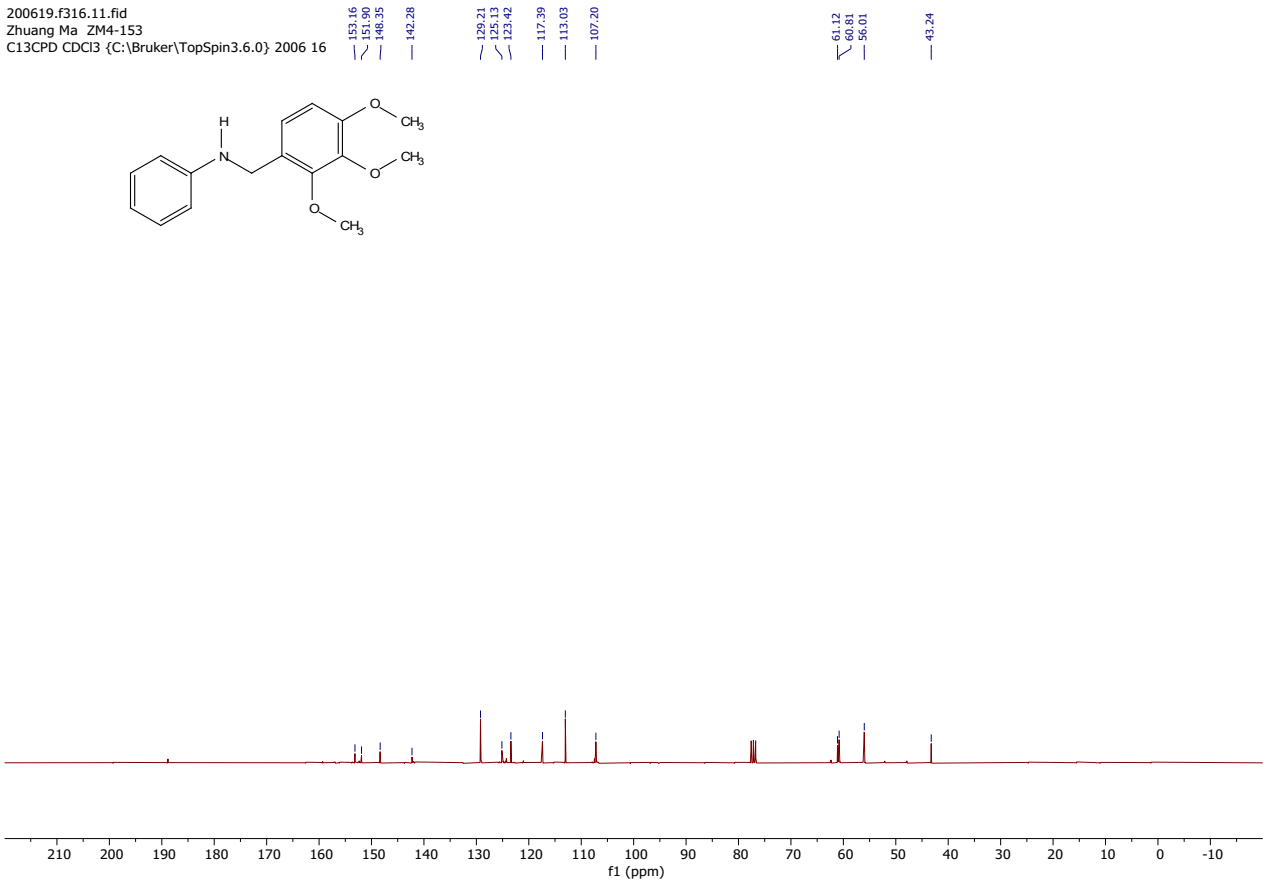
200619.f315.11.fid
Zhuang Ma ZM4-151
C13CPD CDCl3 {C:\Bruker\TopSpin3.6.0} 2006 15



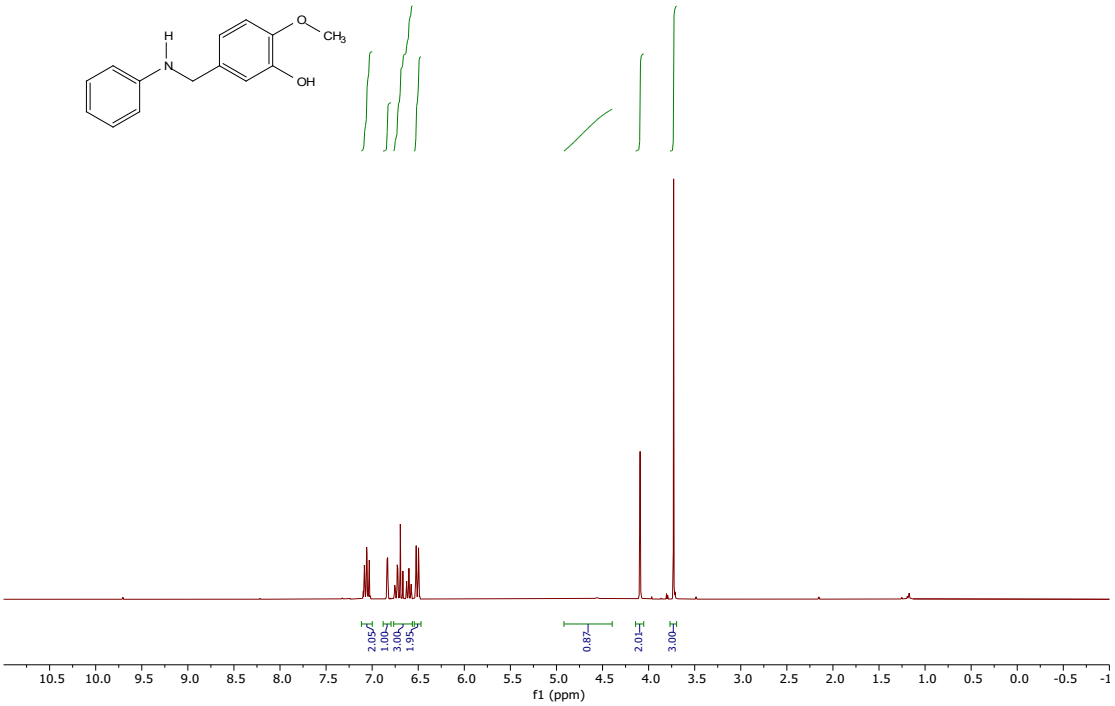
210512.304.11.fid
Zhuang Ma / zm4-25
Au13C DMSO {C:\Bruker\TopSpin3.6.2} 2105 4



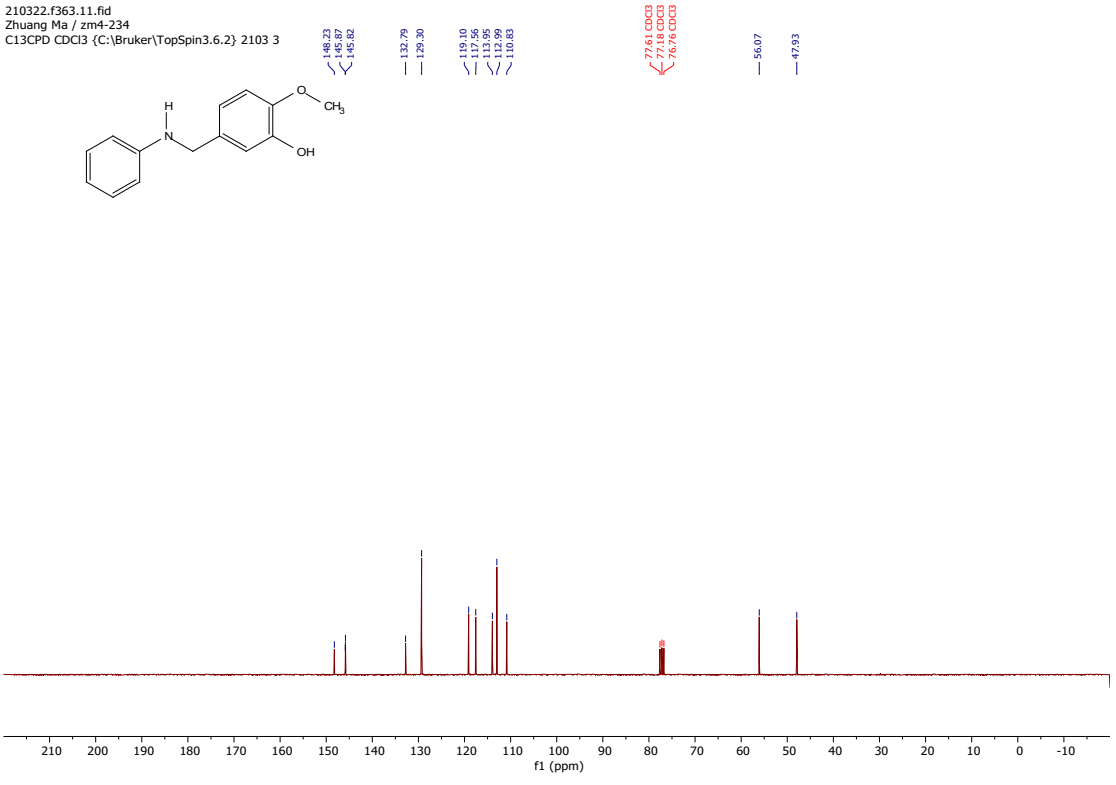
200619.f316.11.fid
Zhuang Ma ZM4-153
C13CPD CDCl3 {C:\Bruker\TopSpin3.6.0} 2006 16

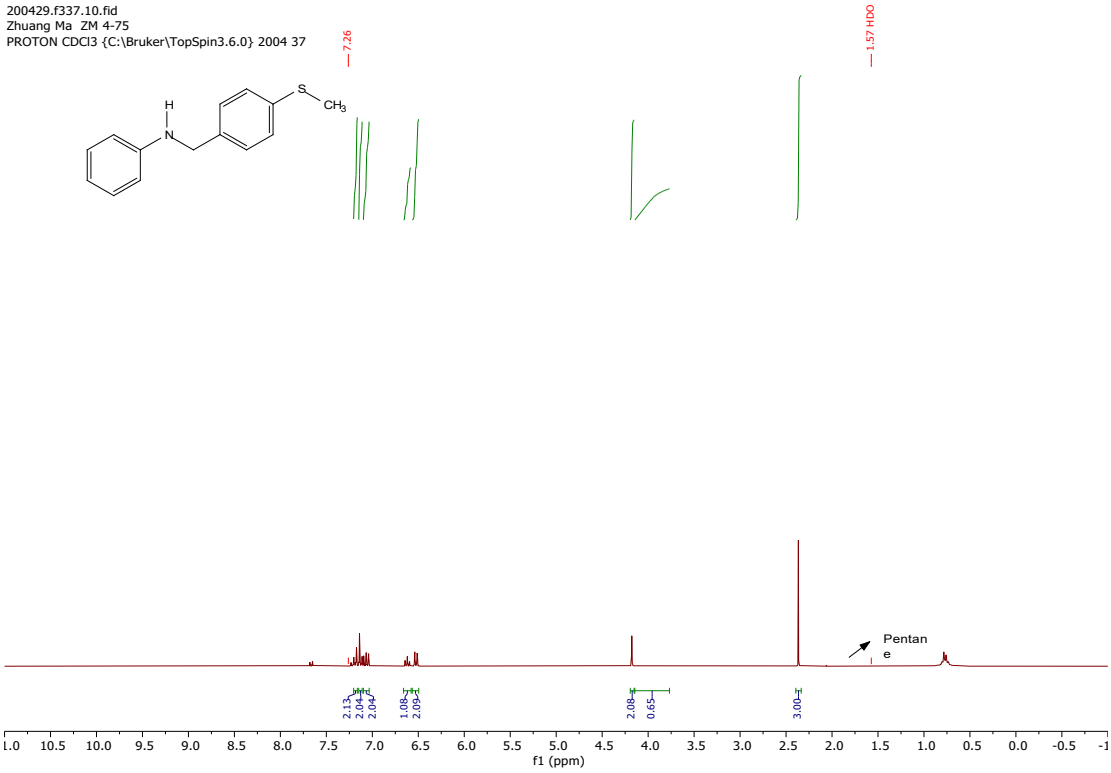


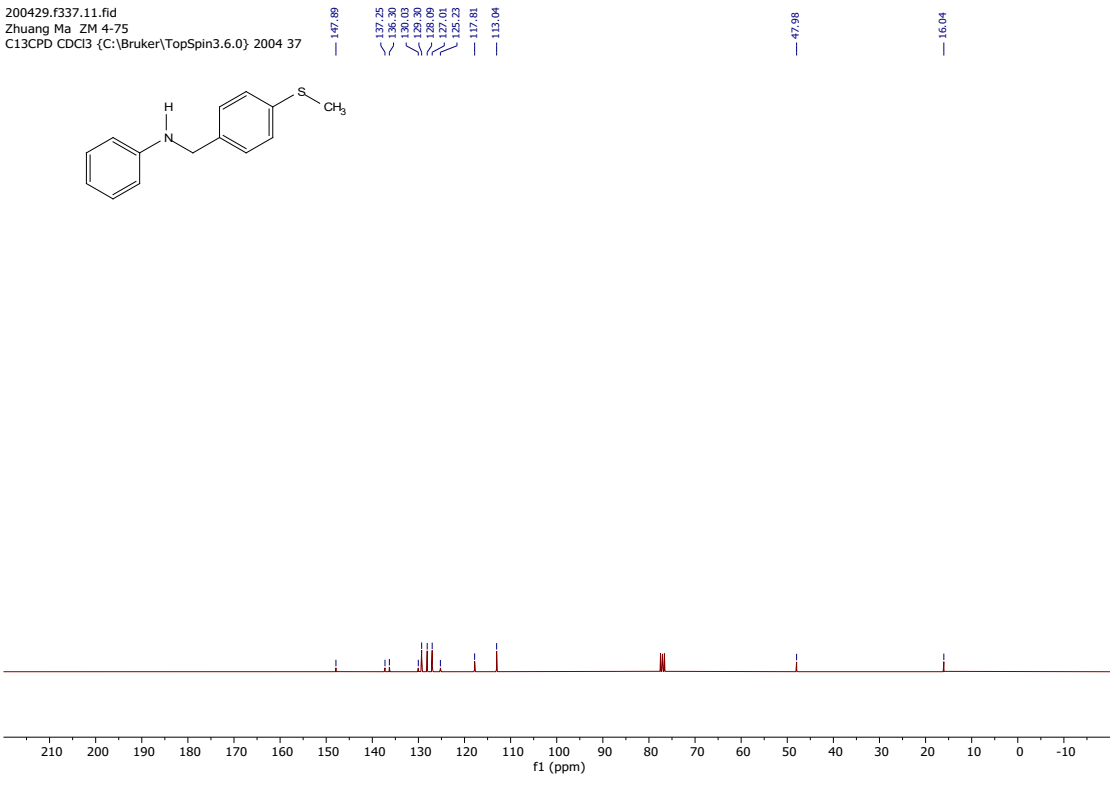
210322.f363.10.fid
Zhuang Ma / zm4-234
PROTON CDCl3 {C:\Bruker\TopSpin3.6.2} 2103 3



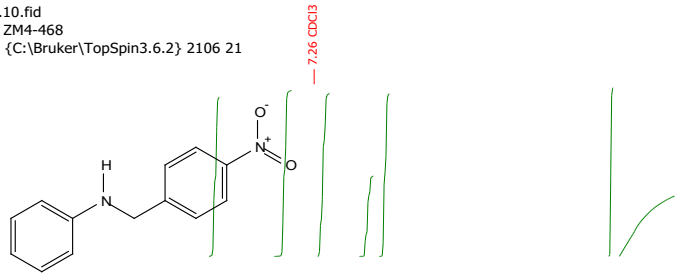
210322.f363.11.fid
Zhuang Ma / zm4-234
C13CPD CDCl3 {C:\Bruker\TopSpin3.6.2} 2103 3

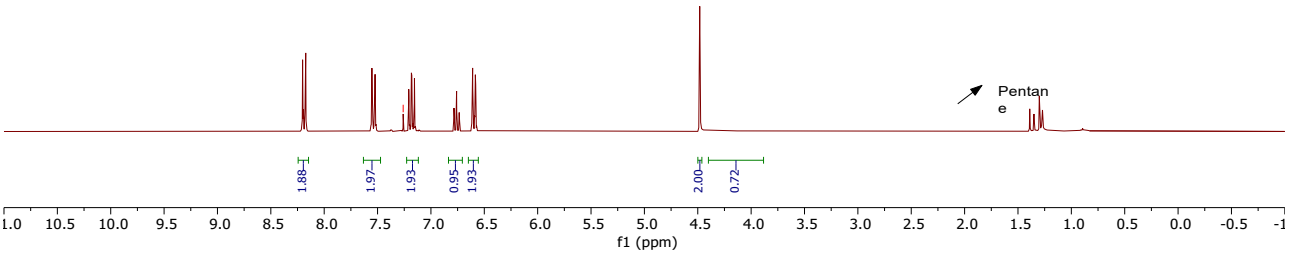



200429.f337.10.fid
Zhuang Ma ZM 4-75
PROTON CDCl3 {C:\Bruker\TopSpin3.6.0} 2004 37
7.26
1.57 HDO
H
N
S
CH3
Pentan
e
2.13
2.04
2.04
1.08
2.09
2.08
0.65
3.00
f1 (ppm)

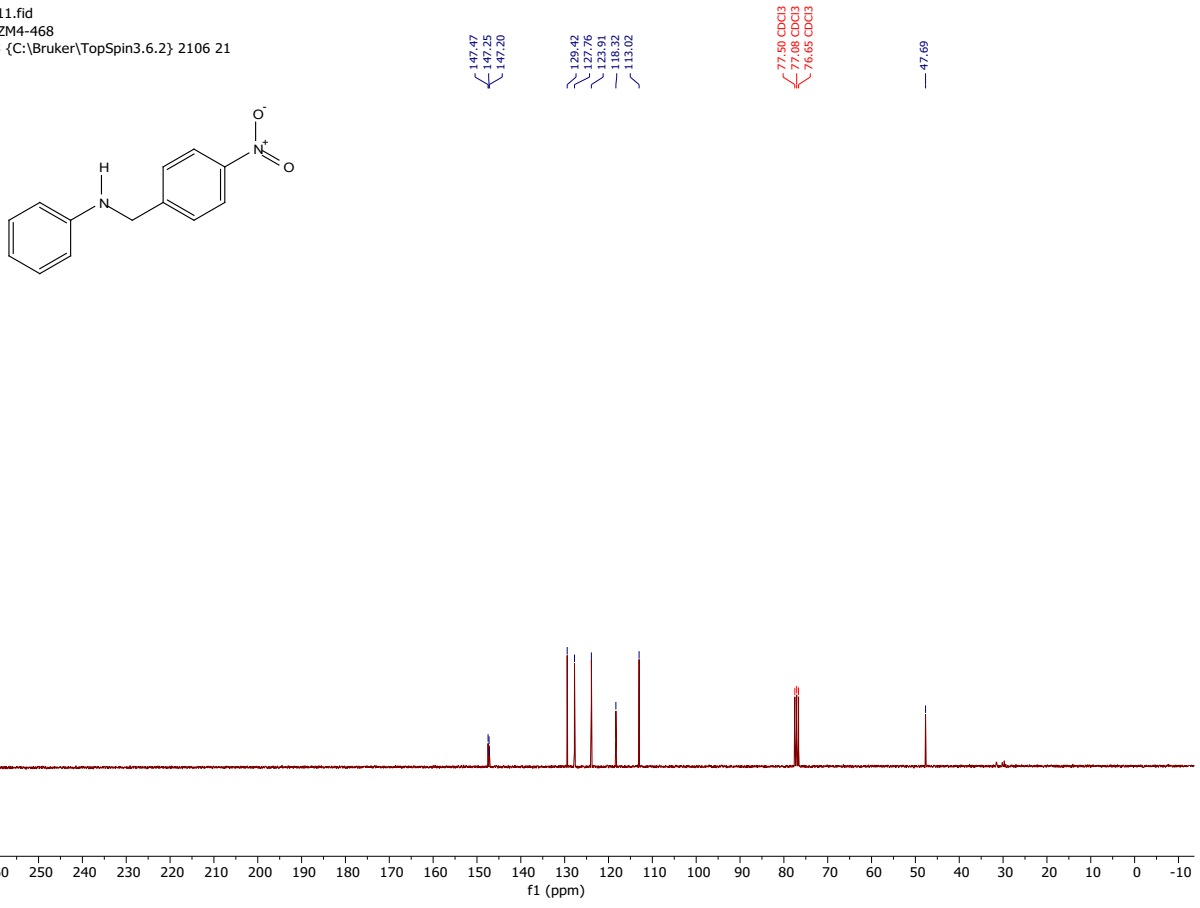

200429.f337.11.fid
Zhuang Ma ZM 4-75
C13CPD CDCl3 {C:\Bruker\TopSpin3.6.0} 2004 37
147.89
137.25
136.30
130.03
129.30
128.09
127.01
125.23
117.81
113.04
47.98
16.04
H
N
S
CH3
f1 (ppm)

210617.321.10.fid
Zhuang Ma ZM4-468
Au1H CDCl3 {C:\Bruker\TopSpin3.6.2} 2106 21

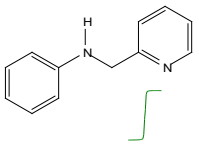




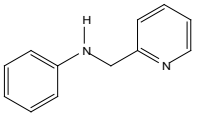
210617.321.11.fid
Zhuang Ma ZM4-468
Au13C CDCl3 {C:\Bruker\TopSpin3.6.2} 2106 21



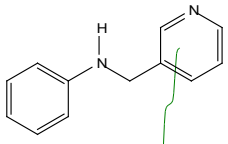
200603.f357.10.fid
Zhuang Ma ZM4-85
PROTON CDCl3 {C:\Bruker\TopSpin3.6.0} 2006 57



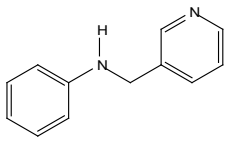
200603.f357.11.fid
Zhuang Ma ZM4-85
C13CPD CDCl3 {C:\Bruker\TopSpin3.6.0} 2006 57



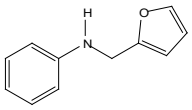
210615.309.10.fid
Zhuang Ma ZM4-465
Au1H CDCl3 {C:\Bruker\TopSpin3.6.2} 2106 9



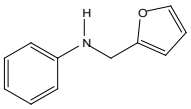
210615.309.11.fid
Zhuang Ma ZM4-465
Au13C CDCl3 {C:\Bruker\TopSpin3.6.2} 2106 9



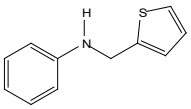
200401.404.10.fid
Zhuang Ma ZM4-62-1
Au1H CDCl3 {C:\Bruker\TopSpin3.5pl6} 2004 4



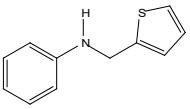
200401.404.11.fid
Zhuang Ma ZM4-62-1
Au13C CDCl3 {C:\Bruker\TopSpin3.5pl6} 2004 4

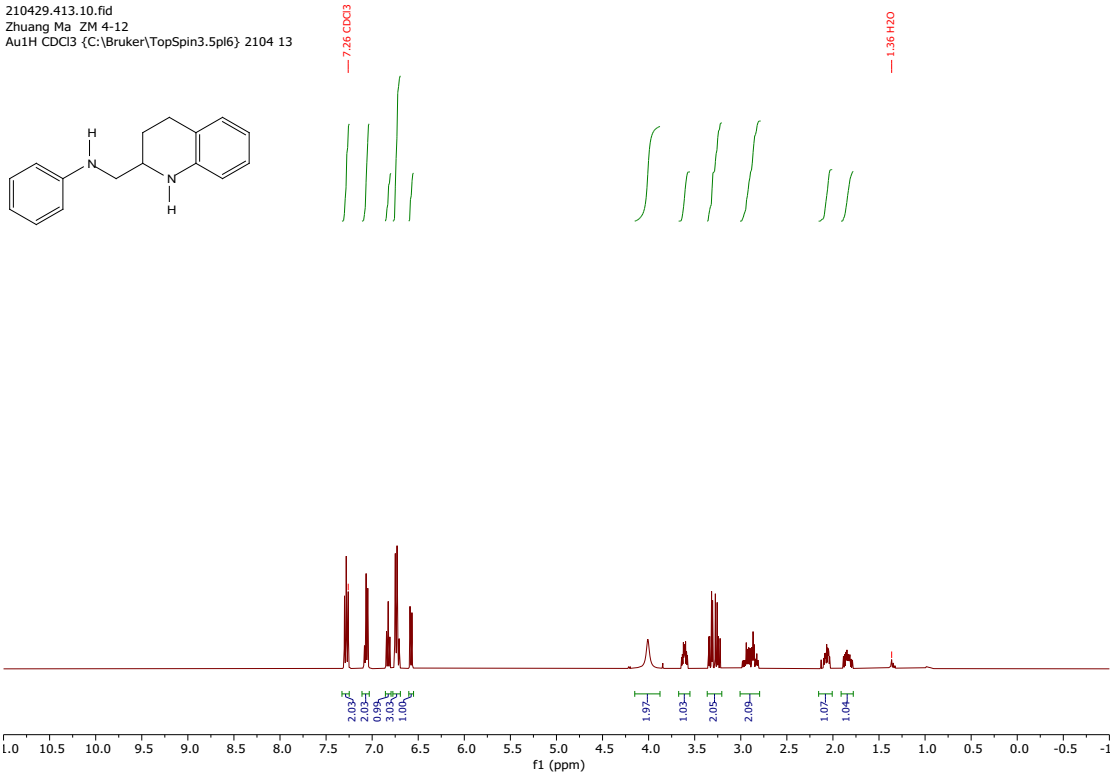


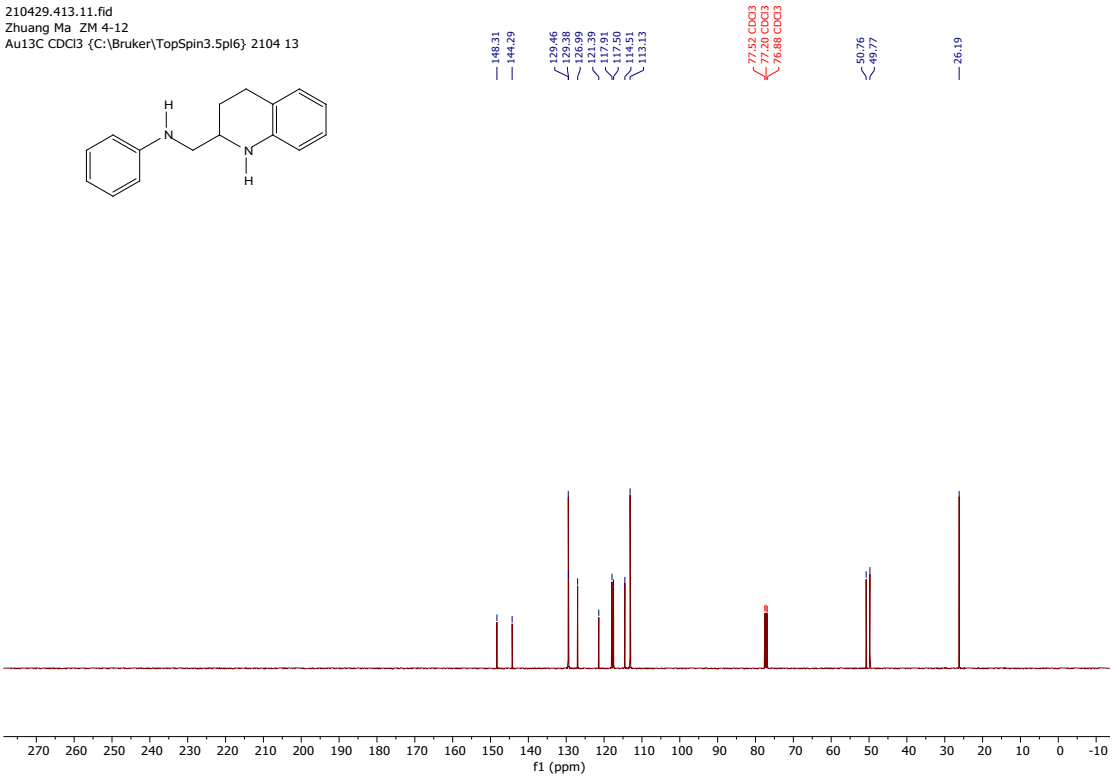
210512.301.10.fid
Zhuang Ma / zm4-18
Au1H CDCl3 {C:\Bruker\TopSpin3.6.2} 2105 1



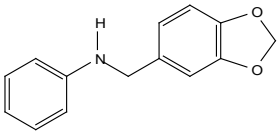
210512.301.11.fid
Zhuang Ma / zm4-18
Au13C CDCl3 {C:\Bruker\TopSpin3.6.2} 2105 1



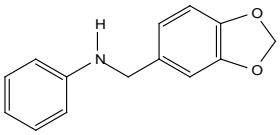

210429.413.10.fid
Zhuang Ma ZM 4-12
Au1H CDCl3 {C:\Bruker\TopSpin3.5pl6} 2104 13
7.26 CDCl3
1.36 H2O
2.03
2.03
6.93
3.03
1.00
1.97
1.03
2.05
2.09
1.07
1.04
f1 (ppm)


210429.413.11.fid
Zhuang Ma ZM 4-12
Au13C CDCl3 {C:\Bruker\TopSpin3.5pl6} 2104 13
148.31
144.29
129.46
129.38
126.99
121.39
117.91
117.50
114.51
113.13
77.52 CDCl3
77.20 CDCl3
76.88 CDCl3
50.76
49.77
26.19
f1 (ppm)

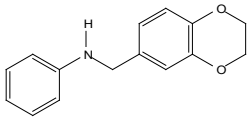
211118.352.10.fid
Zhuang Ma ZM 4-55
Au1H CDCl3 {C:\Bruker\TopSpin3.6.2} 2111 52



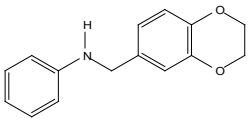
211118.352.11.fid
Zhuang Ma ZM 4-55
Au13C CDCl3 {C:\Bruker\TopSpin3.6.2} 2111 52

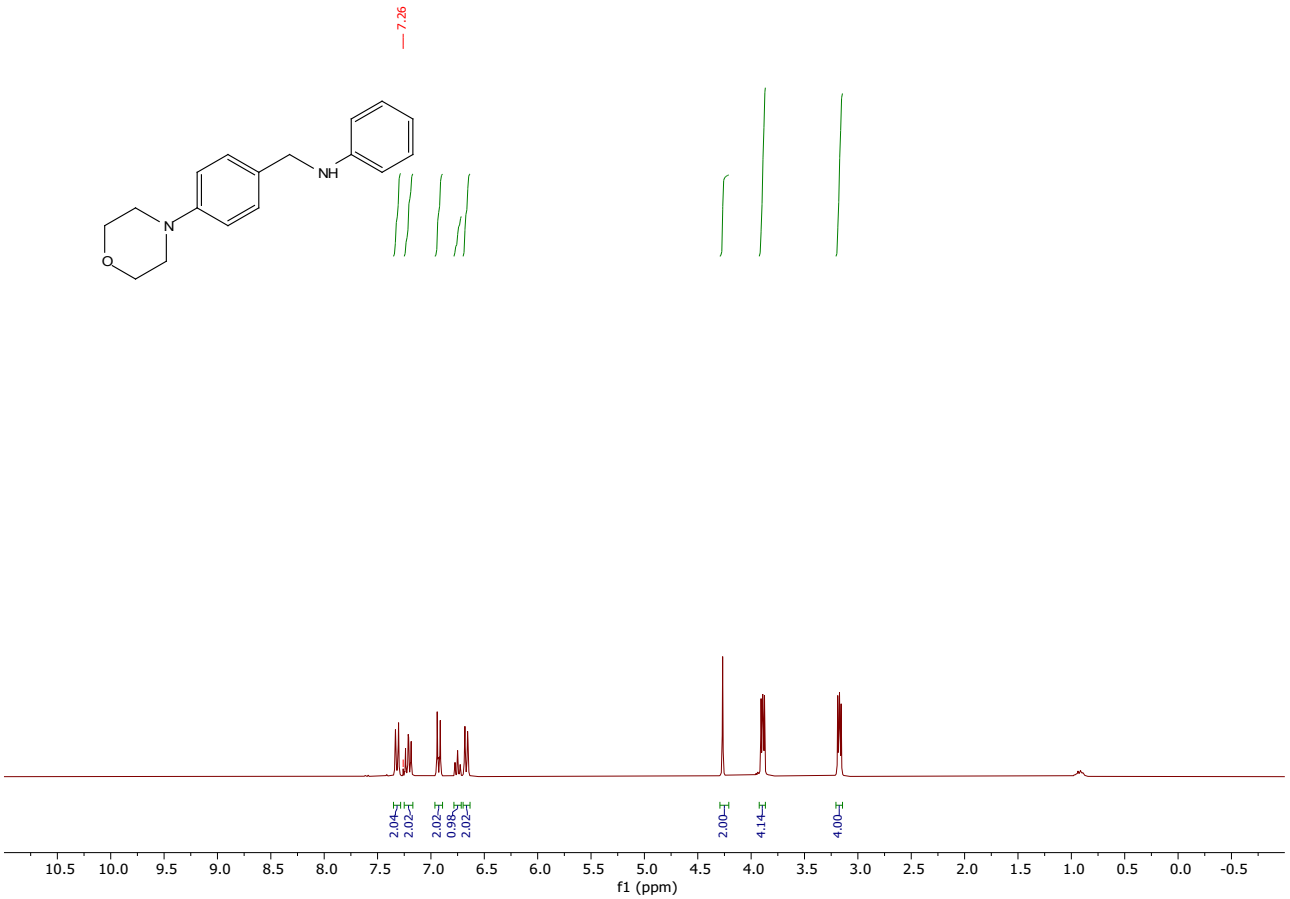


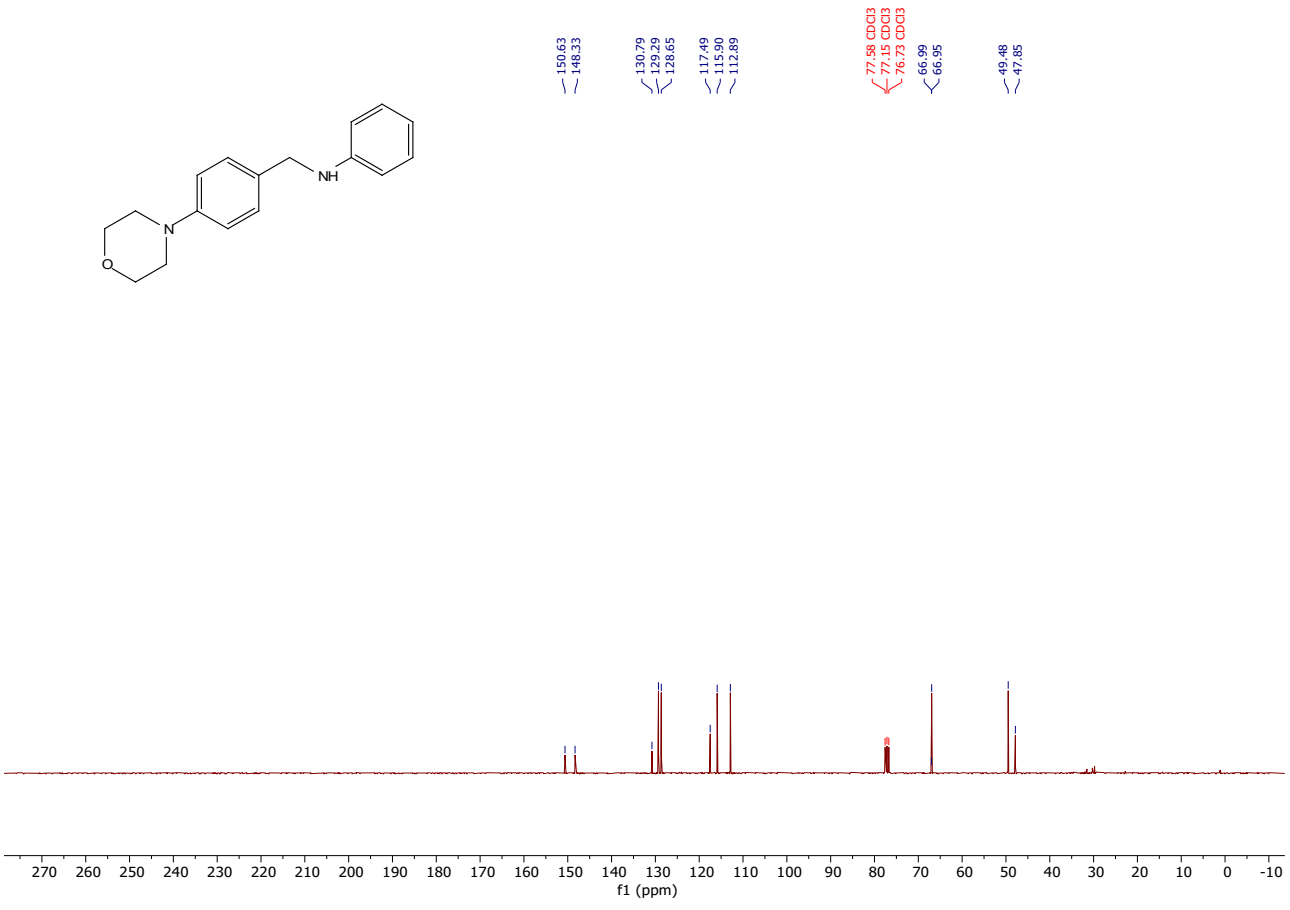
200609.318.10.fid
Zhuang Ma, zm 4-122
Au1H CDCl3 {C:\Bruker\TopSpin3.6.0} 2006 18



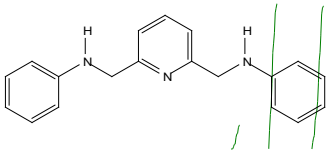
200609.318.11.fid
Zhuang Ma, zm 4-122
Au13C CDCl3 {C:\Bruker\TopSpin3.6.0} 2006 18



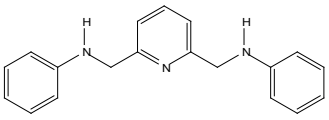

7.26
NH
N
O
2.04
2.02
2.02
0.98
2.02
2.00
4.14
4.00
10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)


150.63
148.33
130.79
129.29
128.65
117.49
115.90
112.89
77.58 CDCl3
77.15 CDCl3
76.73 CDCl3
66.99
66.95
49.48
47.85
NH
N
O
270 260 250 240 230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

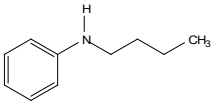
200817.311.11.fid
Zhang ma, ZM 4-135
Au1H CDCl3 {C:\Bruker\TopSpin3.6.0} 2008 11



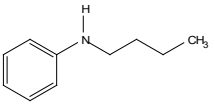
200817.311.10.fid
Zhang ma, ZM 4-135
Au13C CDCl3 {C:\Bruker\TopSpin3.6.0} 2008 11



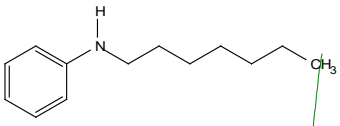
210421.429.10.fid
Zhuang Ma, ZM 4-172
Au1H CDCl3 {C:\Bruker\TopSpin3.5pl6} 2104 29



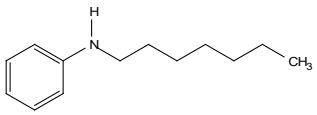
210421.429.11.fid
Zhuang Ma, ZM 4-172
Au13C CDCl3 {C:\Bruker\TopSpin3.5pl6} 2104 29



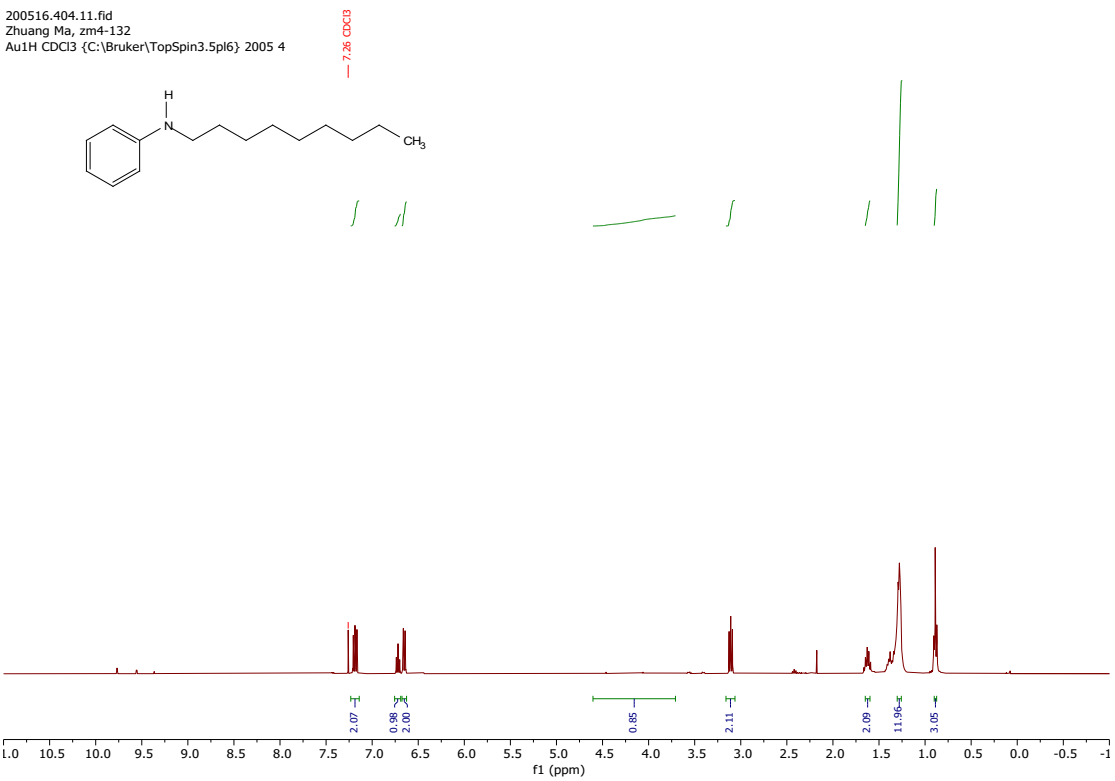
210512.304.11.fid
Zhuang Ma / zm4-25
Au13C DMSO {C:\Bruker\TopSpin3.6.2} 2105 4



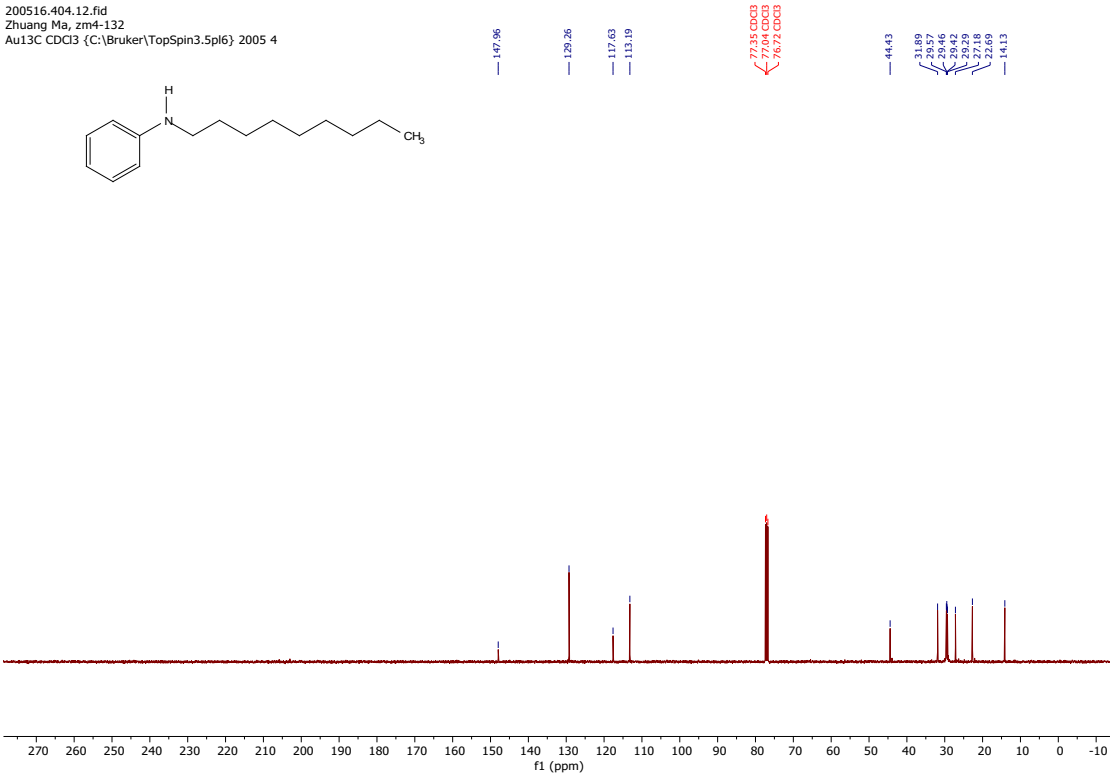
200605.f339.11.fid
ZM 4-183
C13CPD CDCl3 {C:\Bruker\TopSpin3.6.0} 2006 39



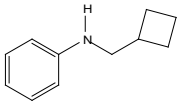
200516.404.11.fid
Zhuang Ma, zm4-132
Au1H CDCl3 {C:\Bruker\TopSpin3.5pl6} 2005 4



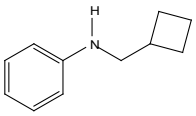
200516.404.12.fid
Zhuang Ma, zm4-132
Au13C CDCl3 {C:\Bruker\TopSpin3.5pl6} 2005 4



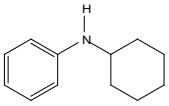
200508.416.10.fid
Zhuang Ma ZM4-63
Au1H CDCl3 {C:\Bruker\TopSpin3.5pl6} 2005 16



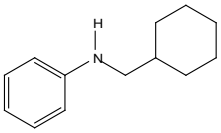
200508.416.11.fid
Zhuang Ma ZM4-63
Au13C CDCl3 {C:\Bruker\TopSpin3.5pl6} 2005 16



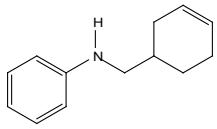
210512.312.10.fid
Zhuang Ma / zm4-214
Au1H CDCl3 {C:\Bruker\TopSpin3.6.2} 2105 12



200427.409.11.fid
Zhuang Ma ZM 4-82
Au13C CDCl3 {C:\Bruker\TopSpin3.5pl6} 2004 9



210901.314.10.fid
Zhuang Ma ZM 4-100
Au1H CDCl3 {C:\Bruker\TopSpin3.6.2} 2109 14



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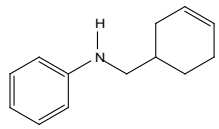
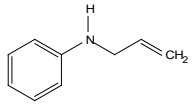
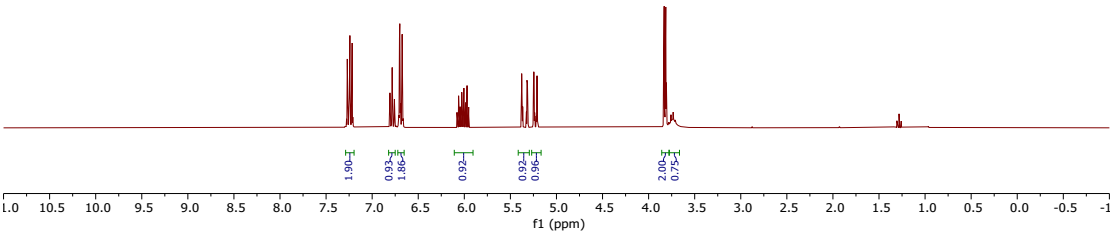
Zhuang Ma ZM 4-100
Au13C CDCl3 {C:\Bruker\TopSpin3.6.2} 2109 14



200603.f360.10.fid
Zhuang Ma ZM4-167
PROTON CDCl3 {C:\Bruker\TopSpin3.6.0} 2006 60





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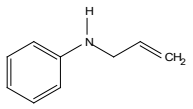
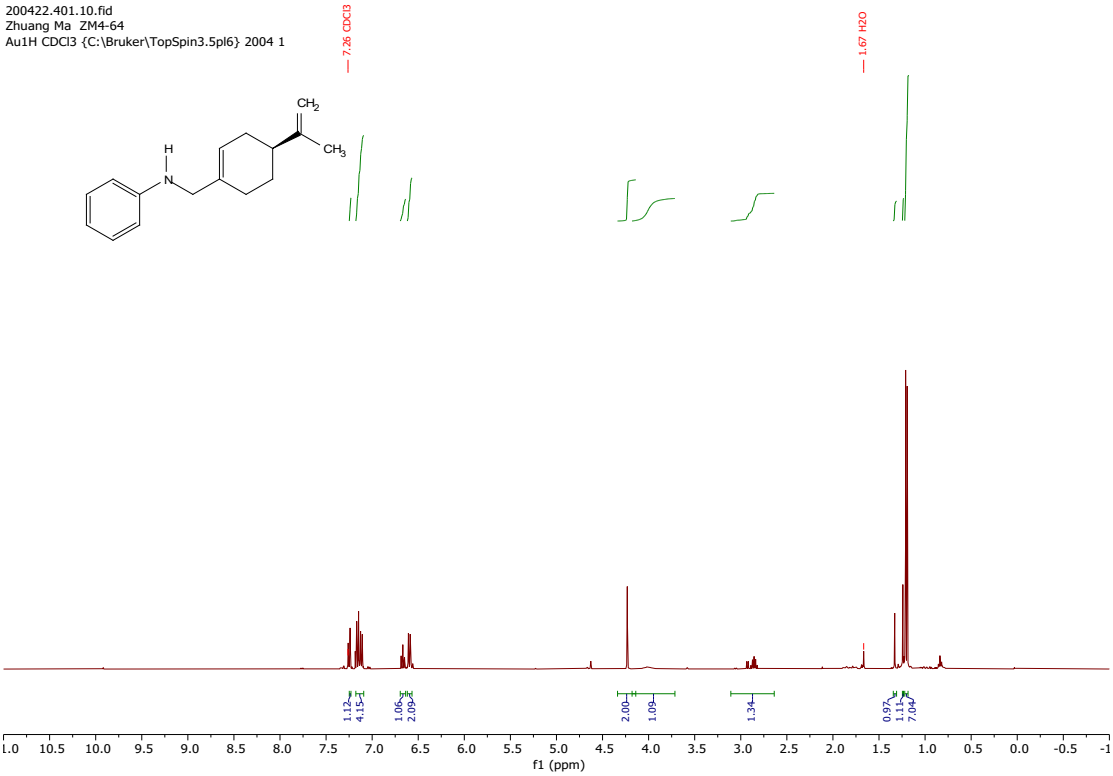
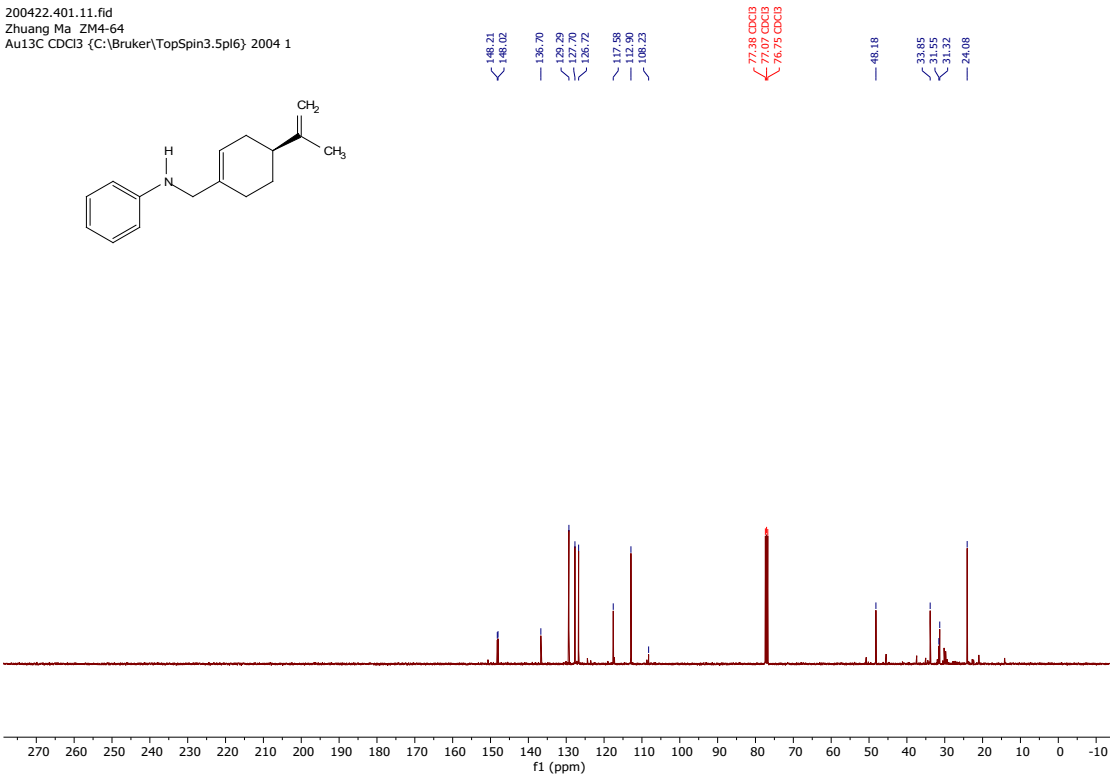
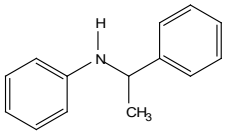
Zhuang Ma ZM4-167
C13CPD CDCl3 {C:\Bruker\TopSpin3.6.0} 2006 60




200422.401.10.fid
Zhuang Ma ZM4-64
Au1H CDCl3 {C:\Bruker\TopSpin3.5pl6} 2004 1
7.26 CDCl3
1.67 H2O
CH2
CH3
H
N
1.12
4.15
1.06
2.09
2.00
1.09
1.34
0.97
1.11
7.04
f1 (ppm)


200422.401.11.fid
Zhuang Ma ZM4-64
Au13C CDCl3 {C:\Bruker\TopSpin3.5pl6} 2004 1
148.21
148.02
136.70
129.29
127.70
126.72
117.58
112.90
108.23
77.38 CDCl3
77.07 CDCl3
76.75 CDCl3
48.18
33.85
31.55
31.32
24.08
CH2
CH3
H
N
f1 (ppm)

210617.316.10.fid
Zhuang Ma ZM4-462-1
Au1H CDCl3 {C:\Bruker\TopSpin3.6.2} 2106 16



210617.316.11.fid
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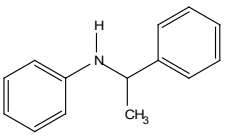
Au13C CDCl3 {C:\Bruker\TopSpin3.6.2} 2106 16



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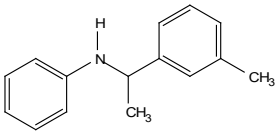
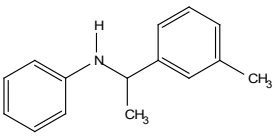
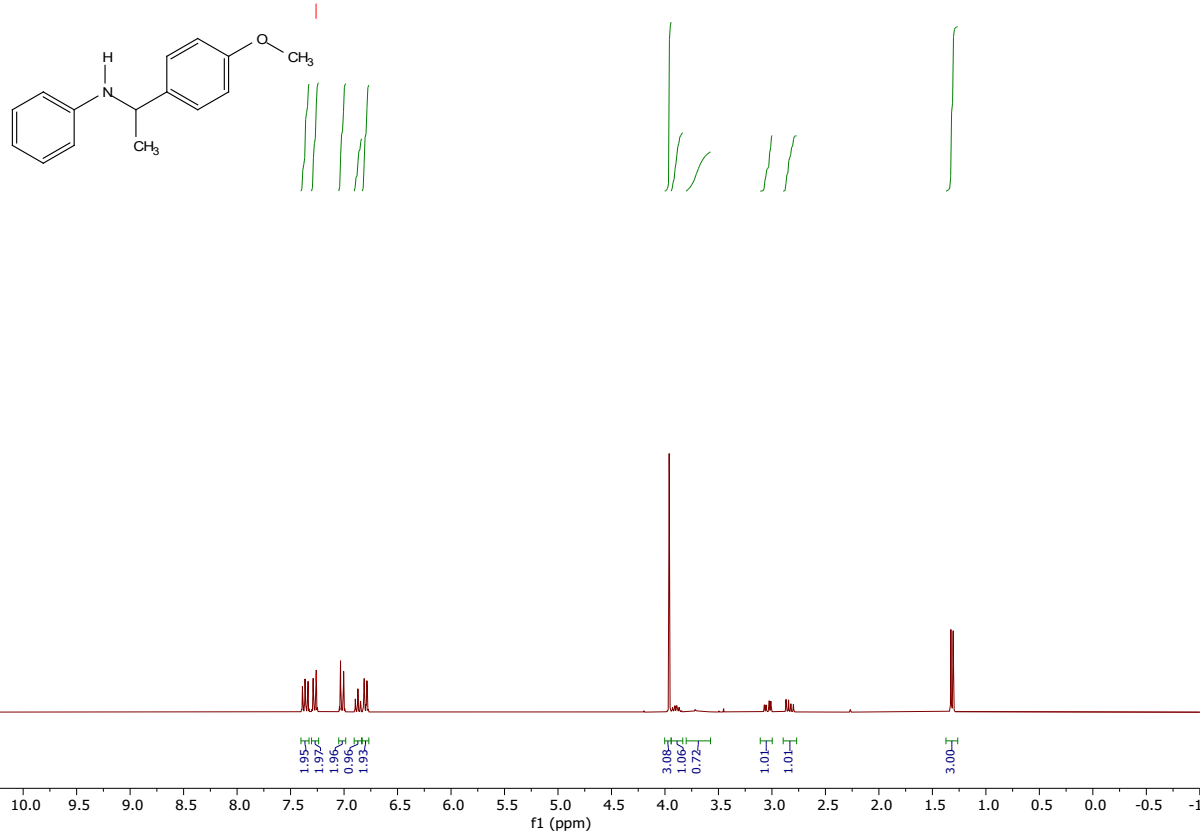
Au1H CDCl3 {C:\Bruker\TopSpin3.6.2} 2106 15



210617.315.11.fid
Zhuang Ma ZM4-467
Au13C CDCl3 {C:\Bruker\TopSpin3.6.2} 2106 15



210615.307.14.fid
Zhuang Ma ZM4-463
Au1H CDCl3 {C:\Bruker\TopSpin3.6.2} 2106 7



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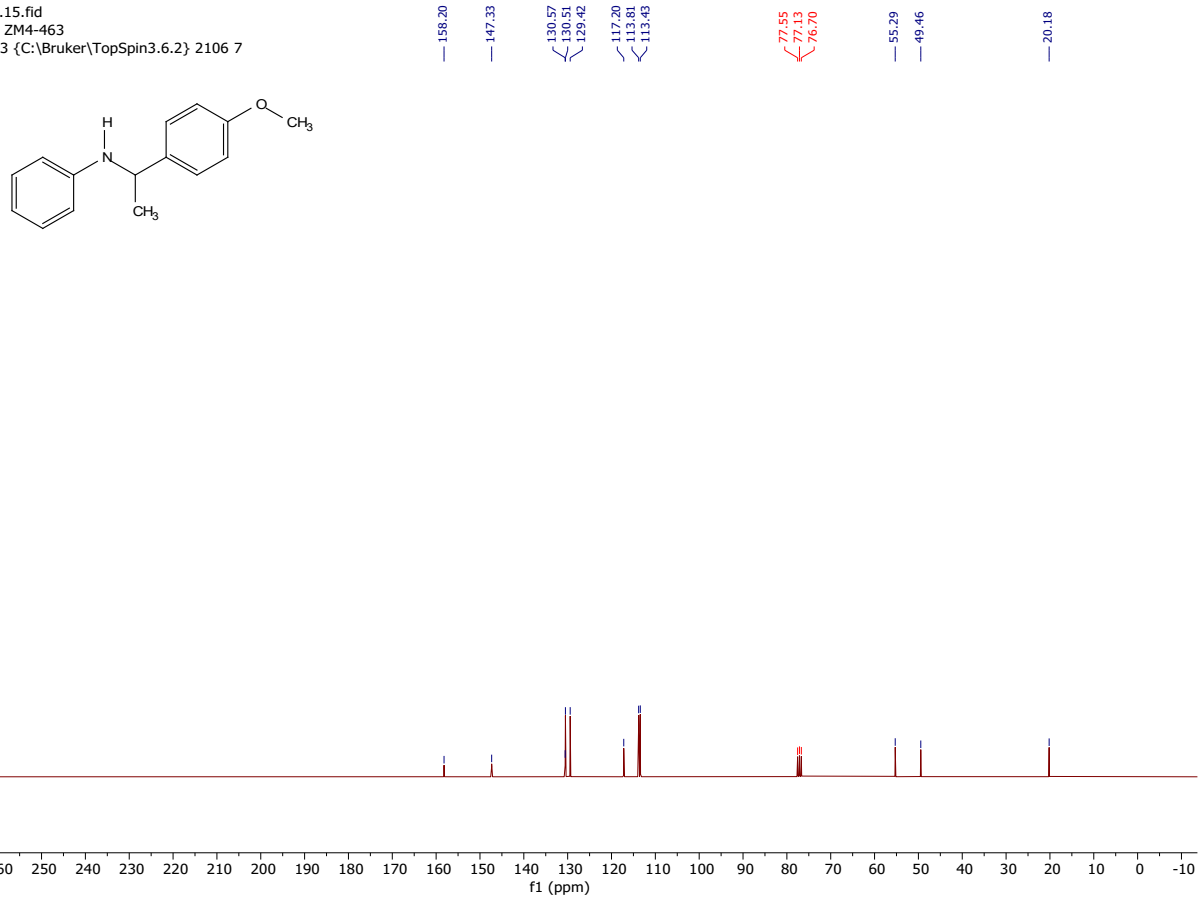
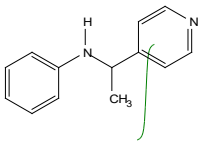
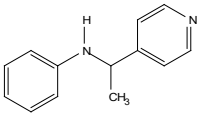
Au13C CDCl3 {C:\Bruker\TopSpin3.6.2} 2106 7



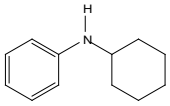
210317.317.10.fid
Zhuang Ma ZM4-236
Au1H CDCl3 {C:\Bruker\TopSpin3.6.2} 2103 17



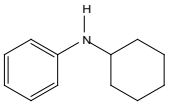
210317.317.11.fid
Zhuang Ma ZM4-236
Au13C CDCl3 {C:\Bruker\TopSpin3.6.2} 2103 17

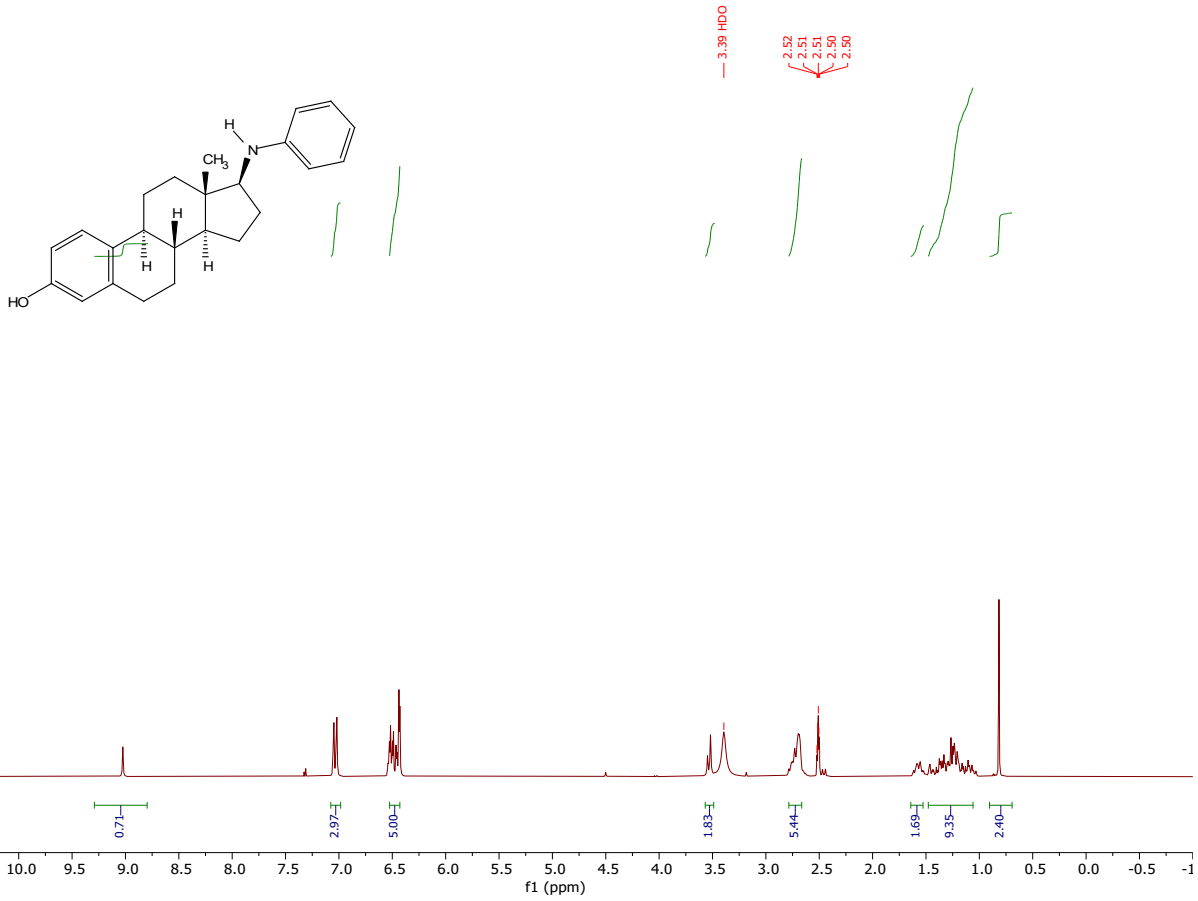


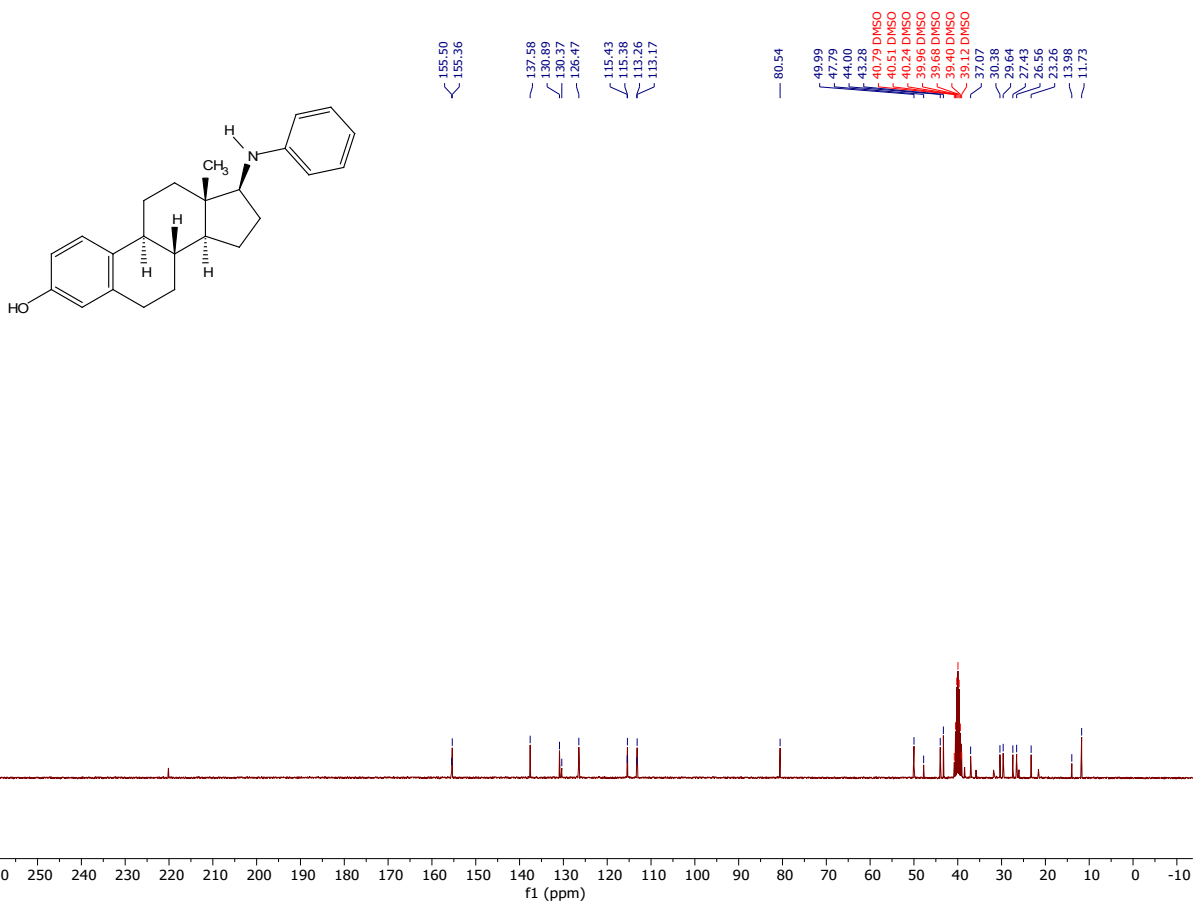
210512.312.10.fid
Zhuang Ma / zm4-214
Au1H CDCl3 {C:\Bruker\TopSpin3.6.2} 2105 12



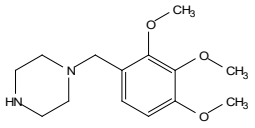
210512.312.11.fid
Zhuang Ma / zm4-214
Au13C CDCl3 {C:\Bruker\TopSpin3.6.2} 2105 12




3.39 HDO
2.52
2.51
2.51
2.50
2.50
0.71
2.97
5.00
1.83
5.44
1.69
9.35
2.40
f1 (ppm)


155.50
155.36
137.58
130.89
130.37
126.47
115.43
115.38
113.26
113.17
80.54
49.99
47.79
44.00
43.28
40.79 DMSO
40.51 DMSO
40.24 DMSO
39.96 DMSO
39.68 DMSO
39.40 DMSO
39.12 DMSO
37.07
30.38
29.64
27.43
26.56
23.26
13.98
11.73
f1 (ppm)

210420.f326.10.fid
Zhuang Ma ZM4d-4
PROTON DMSO {C:\Bruker\TopSpin3.6.2} 2104 26



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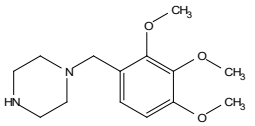
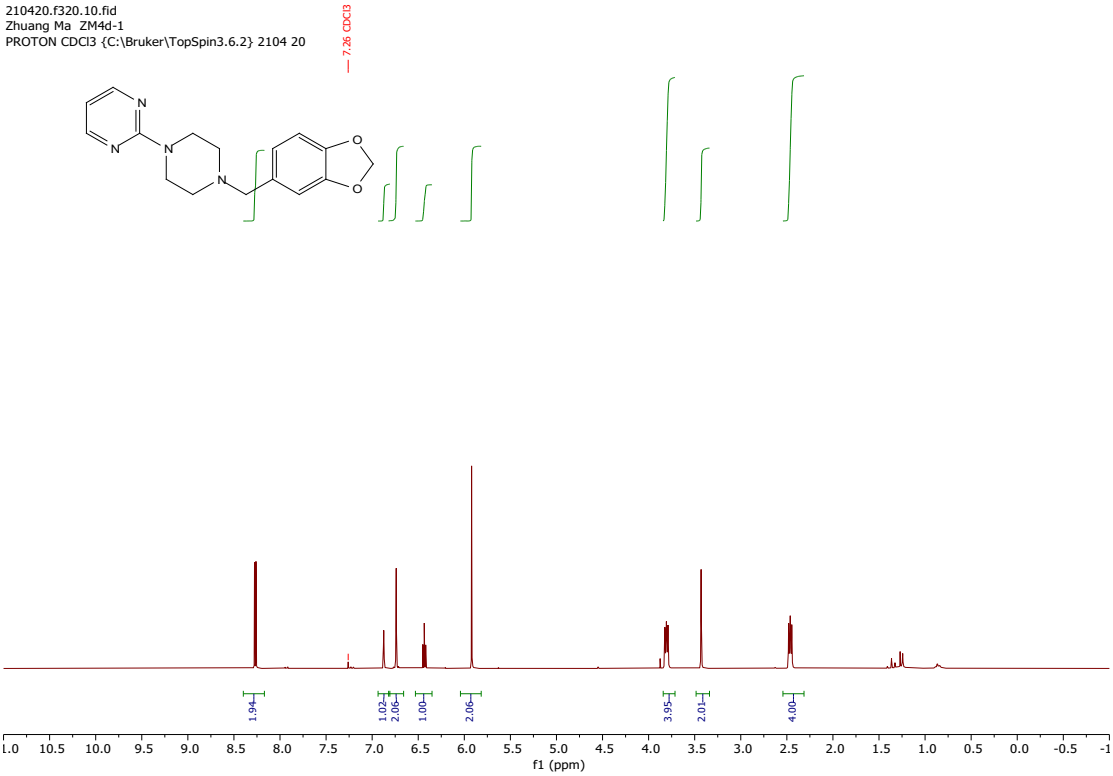
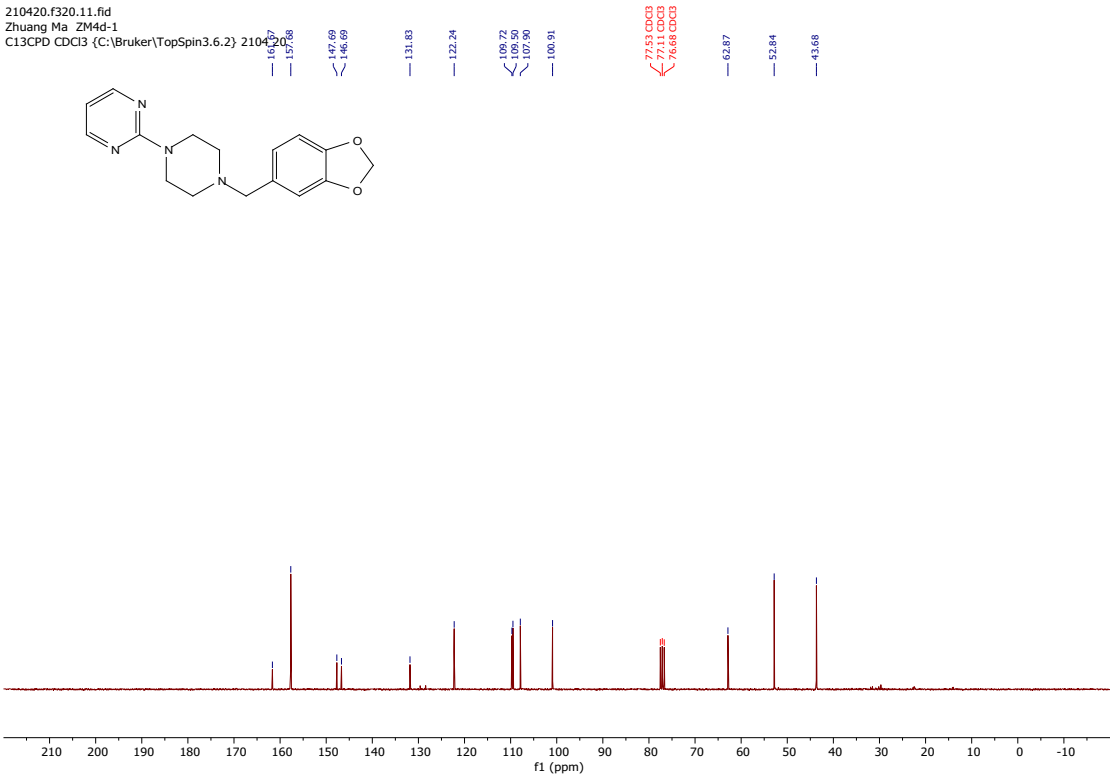
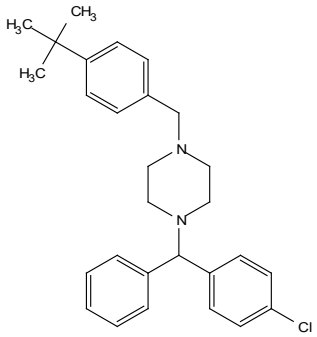
Zhuang Ma ZM4d-4
C13CPD DMSO {C:\Bruker\TopSpin3.6.2} 2104 26




210420.f320.10.fid
Zhuang Ma ZM4d-1
PROTON CDCl3 {C:\Bruker\TopSpin3.6.2} 2104 20
7.26 CDCl3
1.94
1.02
2.06
1.00
2.06
3.95
2.01
4.00
f1 (ppm)


210420.f320.11.fid
Zhuang Ma ZM4d-1
C13CPD CDCl3 {C:\Bruker\TopSpin3.6.2} 2104 20
161.27
157.88
147.69
146.69
131.83
122.24
109.72
109.50
107.90
100.91
77.53 CDCl3
77.11 CDCl3
76.68 CDCl3
62.87
52.84
43.68
f1 (ppm)

211118.353.10.fid
Zhuang Ma ZM 4-75
Au1H CDCl3 {C:\Bruker\TopSpin3.6.2} 2111 53



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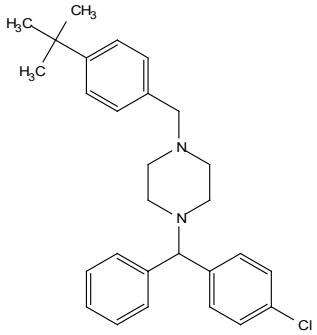
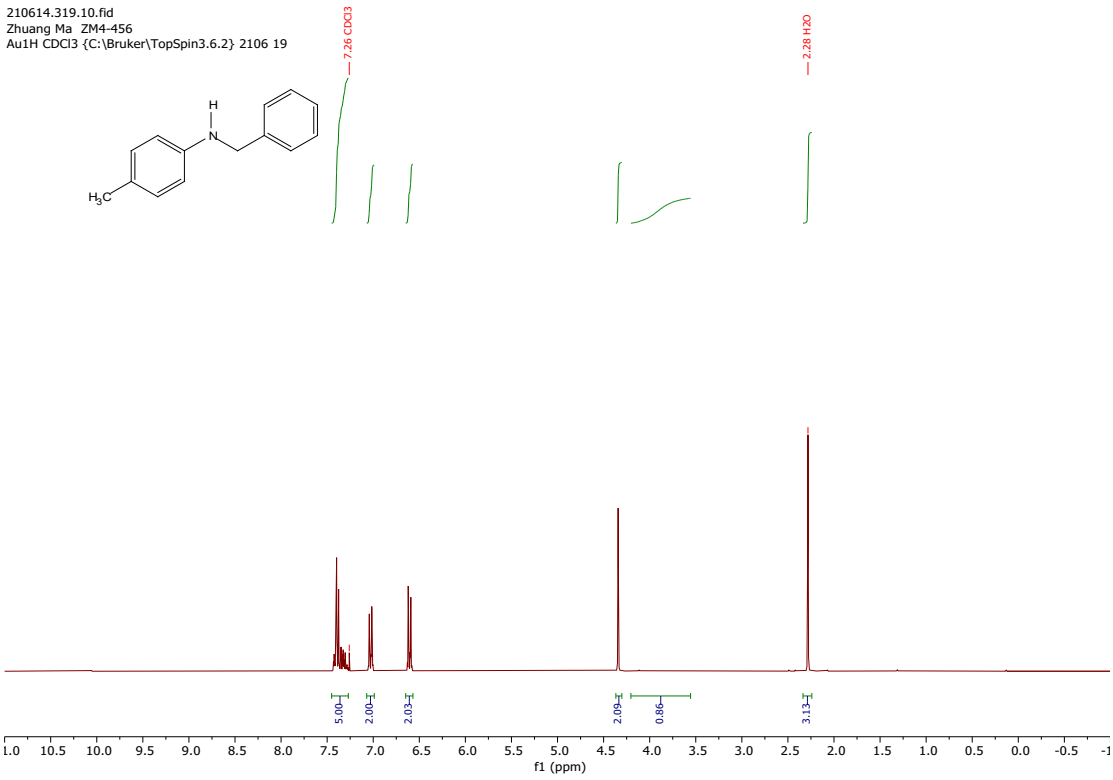
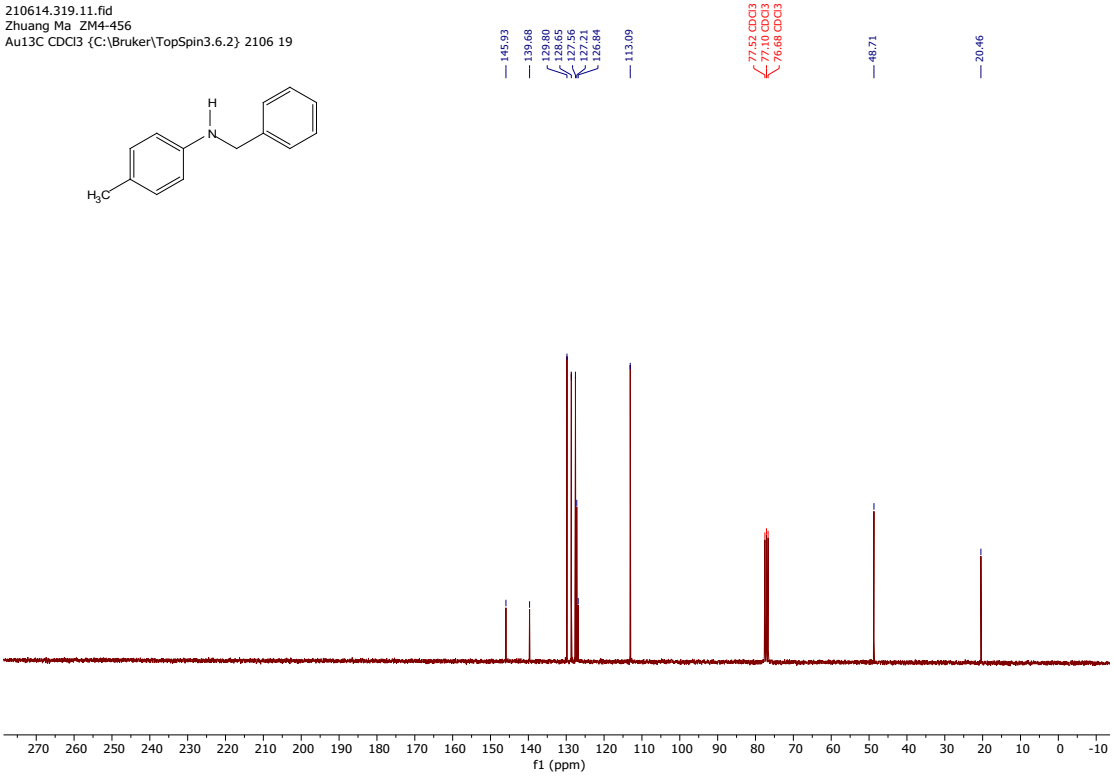
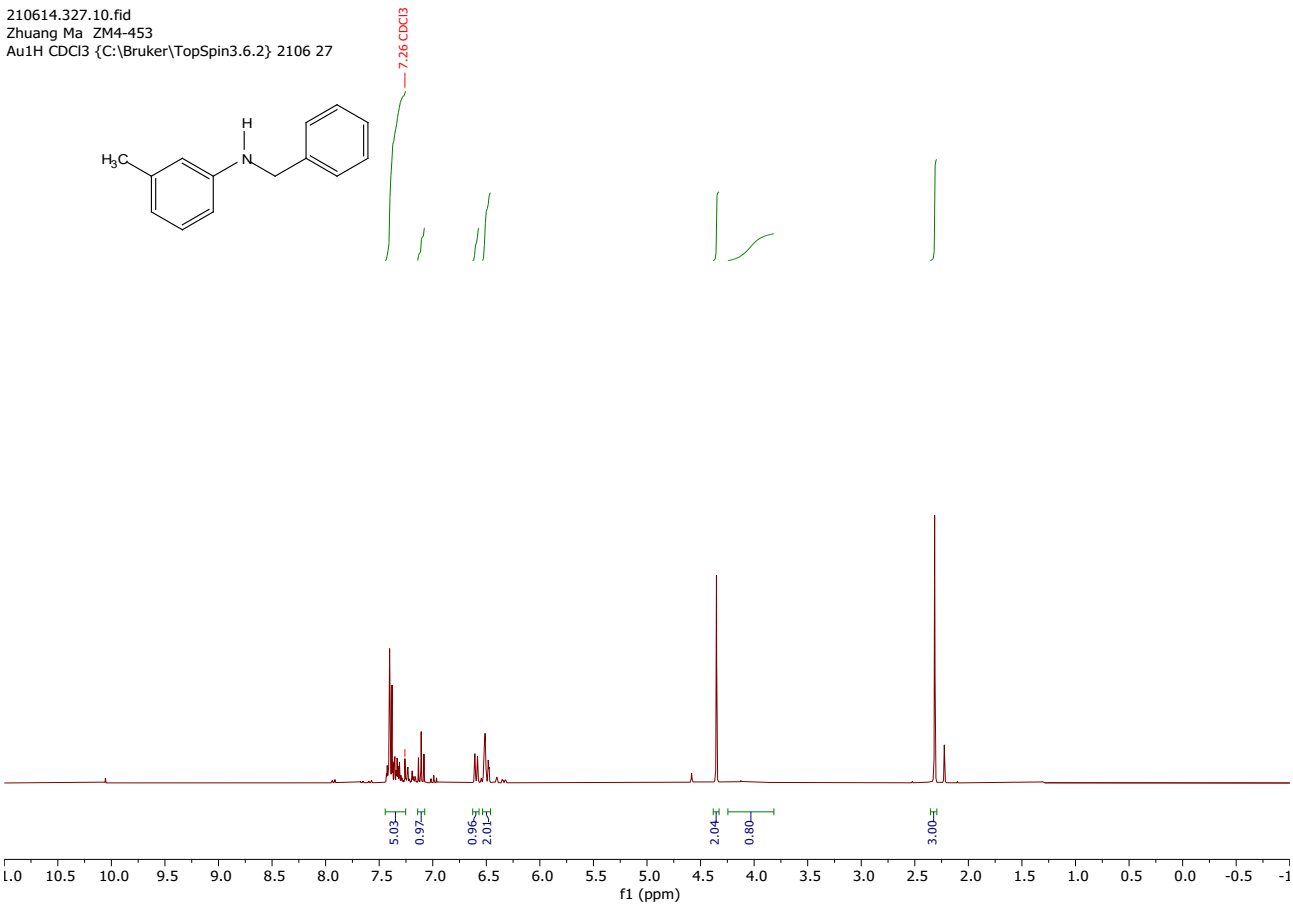
Zhuang Ma ZM 4-75
Au13C CDCl3 {C:\Bruker\TopSpin3.6.2} 2111 53



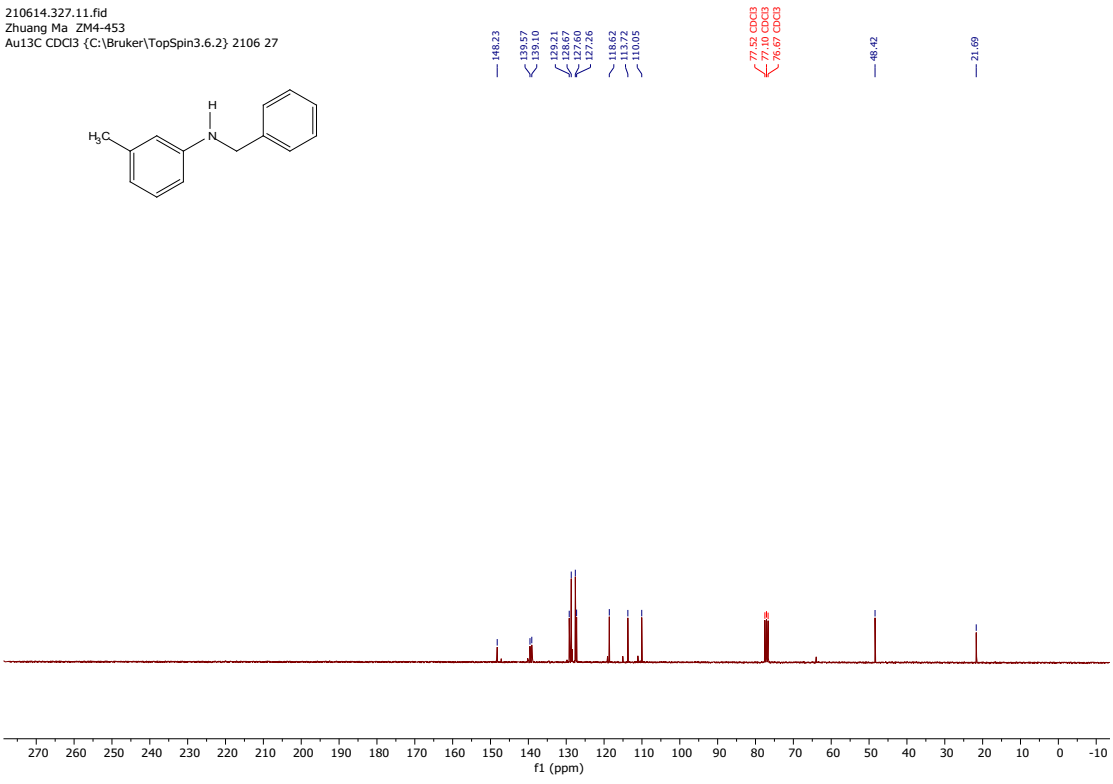

210614.319.10.fid
Zhuang Ma ZM4-456
Au1H CDCl3 {C:\Bruker\TopSpin3.6.2} 2106 19
7.26 CDCl3
2.28 H2O
H
N
H3C
5.00
2.00
2.03
2.09
0.86
3.13
f1 (ppm)


210614.319.11.fid
Zhuang Ma ZM4-456
Au13C CDCl3 {C:\Bruker\TopSpin3.6.2} 2106 19
145.93
139.68
129.80
128.65
127.56
127.21
126.84
113.09
77.52 CDCl3
77.10 CDCl3
76.68 CDCl3
48.71
20.46
H
N
H3C
f1 (ppm)

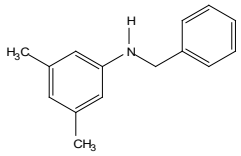
210614.327.10.fid
Zhuang Ma ZM4-453
Au1H CDCl3 {C:\Bruker\TopSpin3.6.2} 2106 27



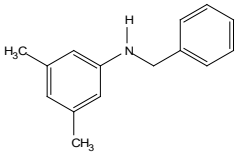
210614.327.11.fid
Zhuang Ma ZM4-453
Au13C CDCl3 {C:\Bruker\TopSpin3.6.2} 2106 27



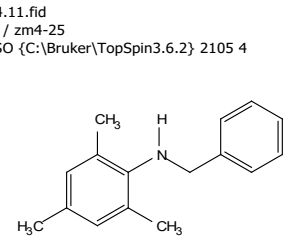
200608.f376.10.fid
Ma/ ZM4-1
PROTON CDCl3 {C:\Bruker\TopSpin3.6.0} 2006 16



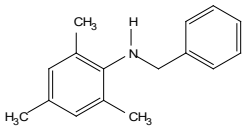
200608.f376.11.fid
Ma/ ZM4-1
C13CPD CDCl3 {C:\Bruker\TopSpin3.6.0} 2006 16



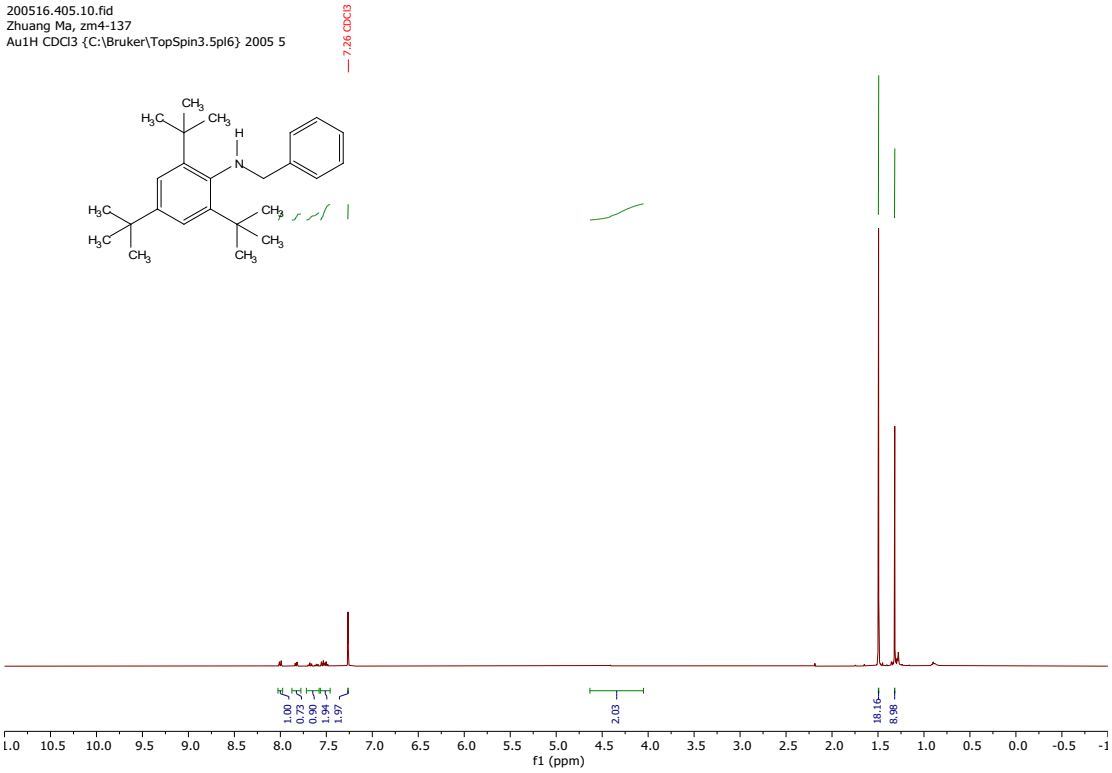
210512.304.11.fid
Zhuang Ma / zm4-25
Au13C DMSO {C:\Bruker\TopSpin3.6.2} 2105 4



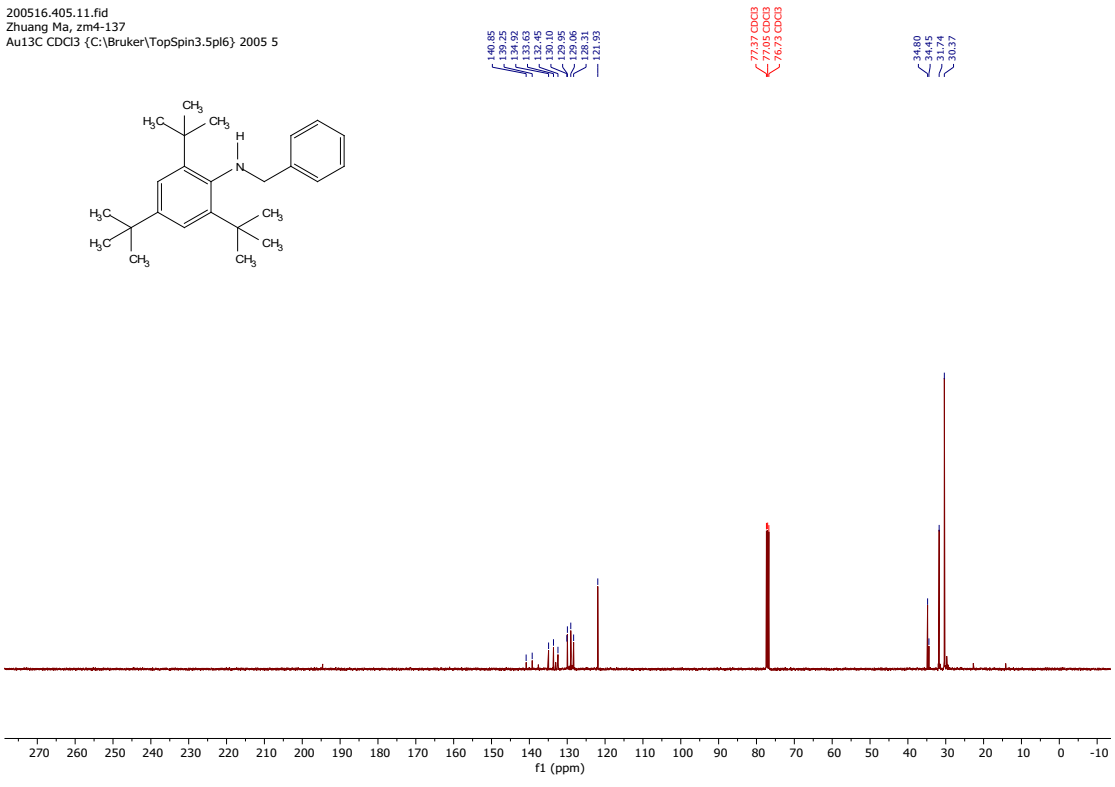
210512.304.11.fid
Zhuang Ma / zm4-25
Au13C DMSO {C:\Bruker\TopSpin3.6.2} 2105 4



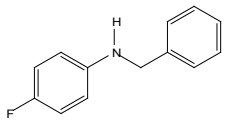
200516.405.10.fid
Zhuang Ma, zm4-137
Au1H CDCl3 {C:\Bruker\TopSpin3.5pl6} 2005 5



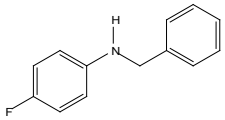
200516.405.11.fid
Zhuang Ma, zm4-137
Au13C CDCl3 {C:\Bruker\TopSpin3.5pl6} 2005 5



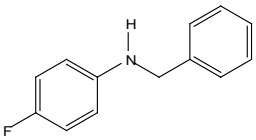
210421.428.10.fid
Zhuang Ma, ZM 4-108
Au1H CDCl3 {C:\Bruker\TopSpin3.5pl6} 2104 28

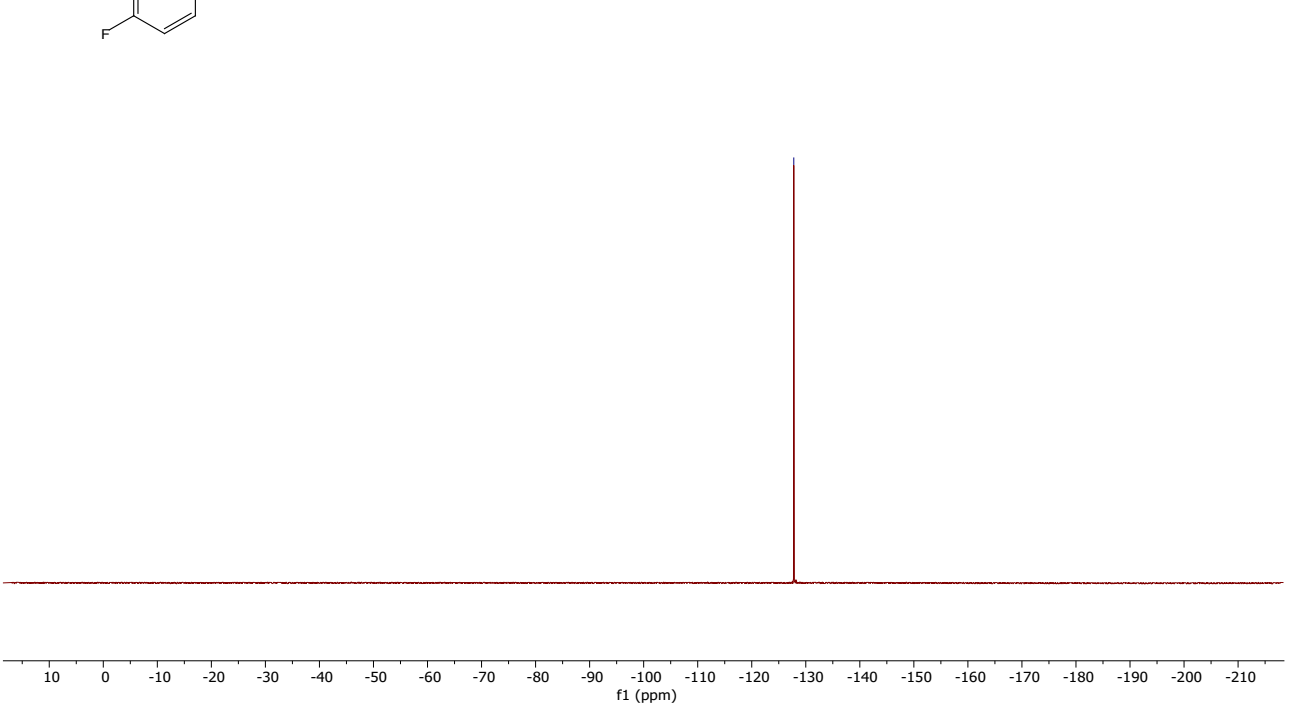


210421.428.11.fid
Zhuang Ma, ZM 4-108
Au13C CDCl3 {C:\Bruker\TopSpin3.5pl6} 2104 28

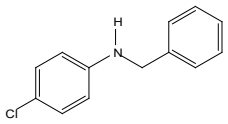


210423.447.10.fid
Zhuang Ma ZM4-108
F19 CDCl3 {C:\Bruker\TopSpin3.5pl6} 2104 47

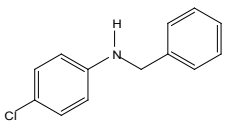




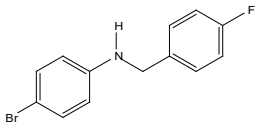
210614.326.10.fid
Zhuang Ma ZM4-450
Au1H CDCl3 {C:\Bruker\TopSpin3.6.2} 2106 26



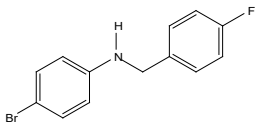
210614.326.11.fid
Zhuang Ma ZM4-450
Au13C CDCl3 {C:\Bruker\TopSpin3.6.2} 2106 26

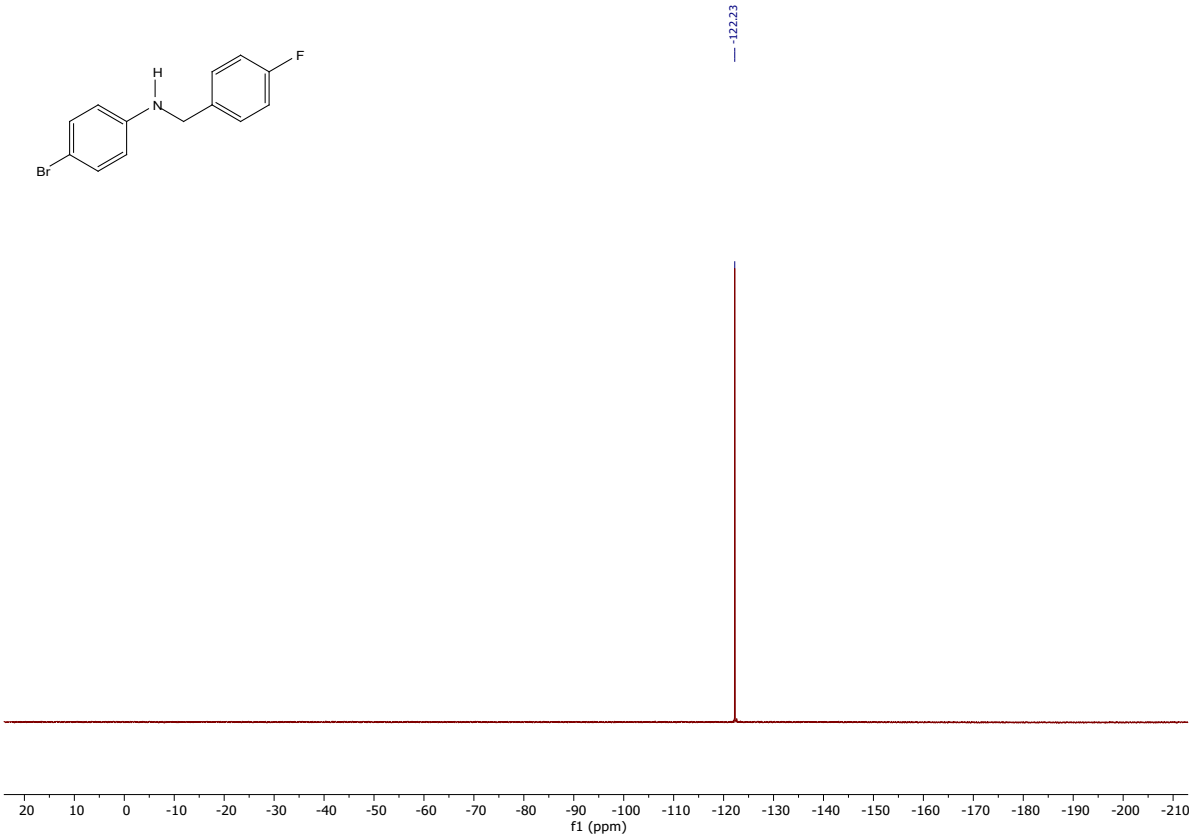


210511.329.10.fid
Ma/ ZM4-18
Au1H CDCl3 {C:\Bruker\TopSpin3.6.2} 2105 29

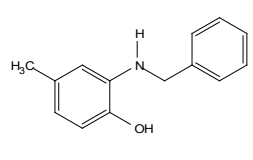


210511.329.10.fid
Ma/ ZM4-18
Au13C CDCl3 {C:\Bruker\TopSpin3.6.2} 2105 29

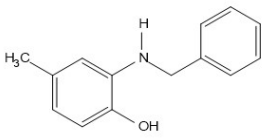


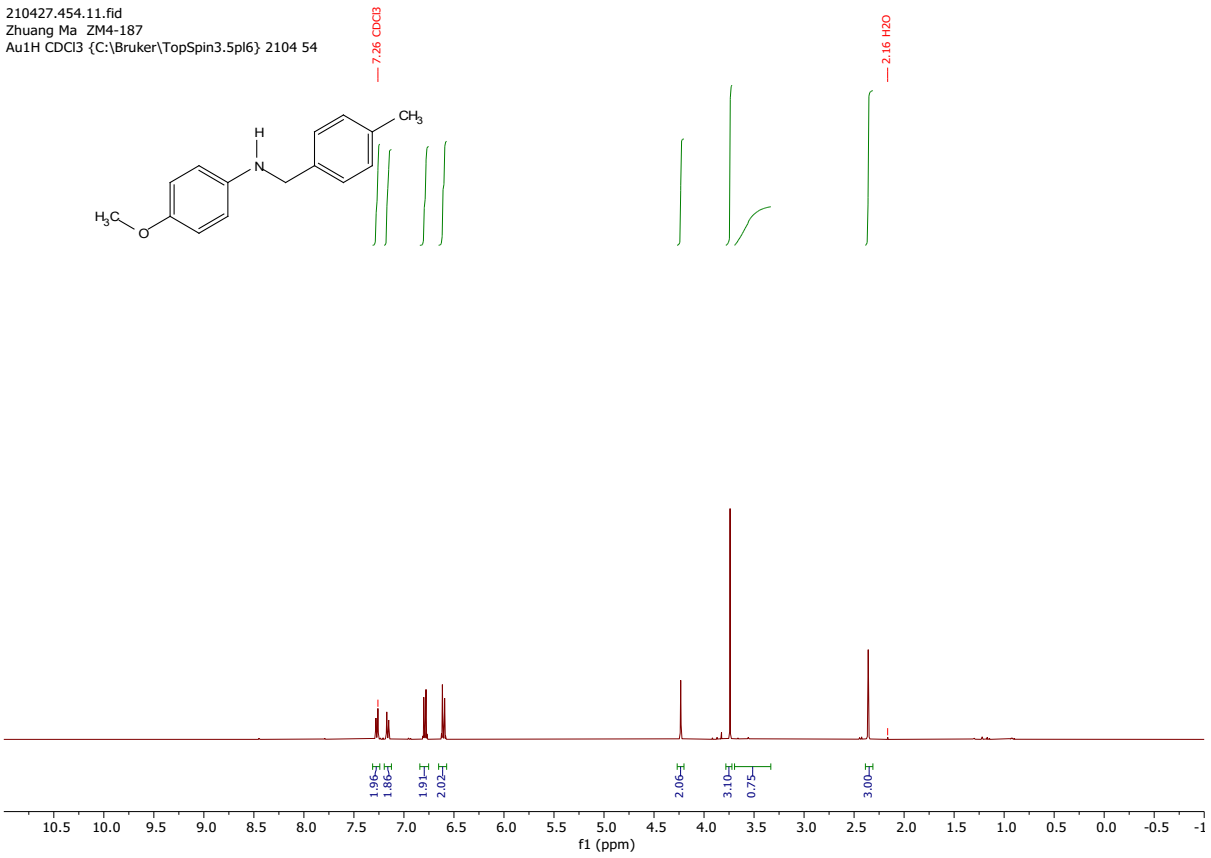

H
N
F
Br
-122.23
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
-160
-170
-180
-190
-200
-210
f1 (ppm)

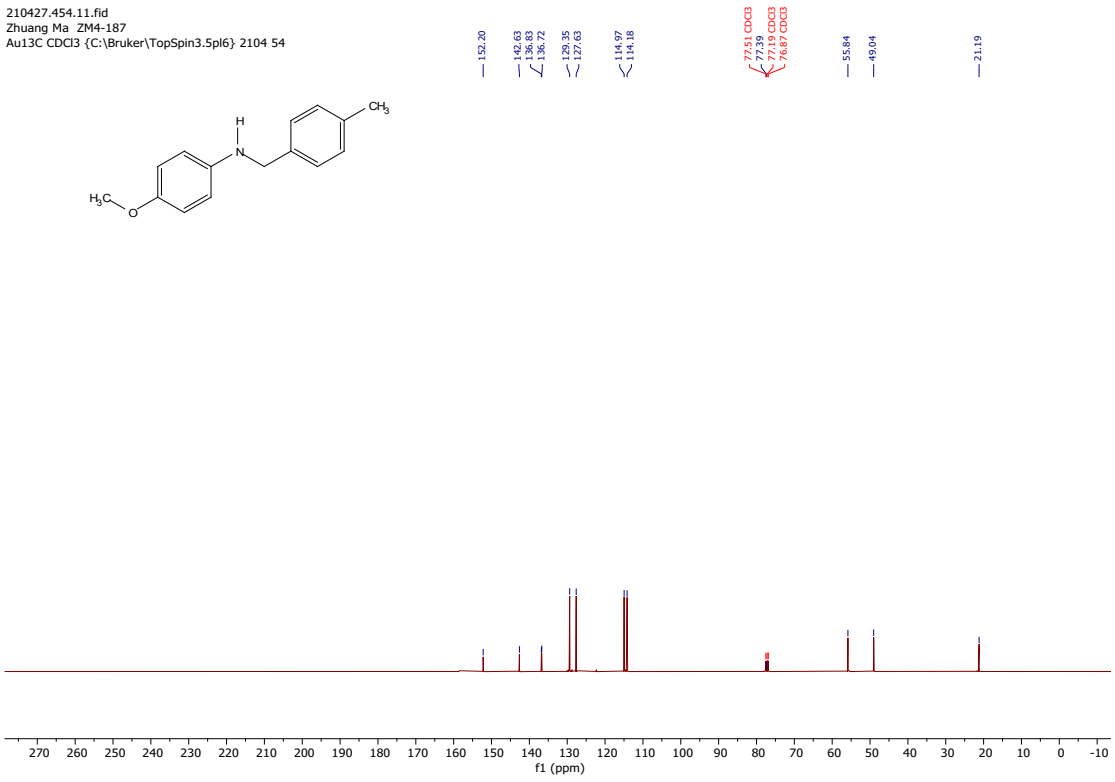
200525.f333.11.fid
Zuhang Ma ZM4-184-2
H1CPD CDCl3 {C:\Bruker\TopSpin3.6.0} 2005 33



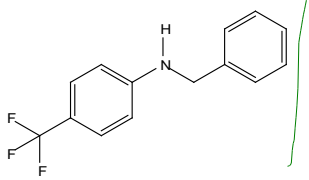
211115.f333.11.fid
Zuhang Ma ZM4-184-2
C13CPD CDCl3 {C:\Bruker\TopSpin3.6.0} 2005 33



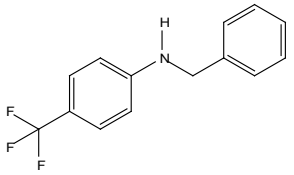

210427.454.11.fid
Zhuang Ma ZM4-187
Au1H CDCl3 {C:\Bruker\TopSpin3.5pl6} 2104 54
7.26 CDCl3
2.16 H2O
CH3
H
N
H3C
O
1.96
1.86
1.91
2.02
2.06
3.10
0.75
3.00
10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)


210427.454.11.fid
Zhuang Ma ZM4-187
Au13C CDCl3 {C:\Bruker\TopSpin3.5pl6} 2104 54
152.20
142.63
136.83
136.72
129.35
127.63
114.97
114.18
77.51 CDCl3
77.19
77.00 CDCl3
76.87 CDCl3
55.84
49.04
21.19
CH3
H
N
H3C
O
270 260 250 240 230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

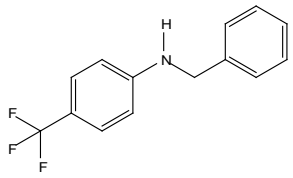
210615.306.10.fid
Zhuang Ma ZM4-454
Au1H CDCl3 {C:\Bruker\TopSpin3.6.2} 2106 6

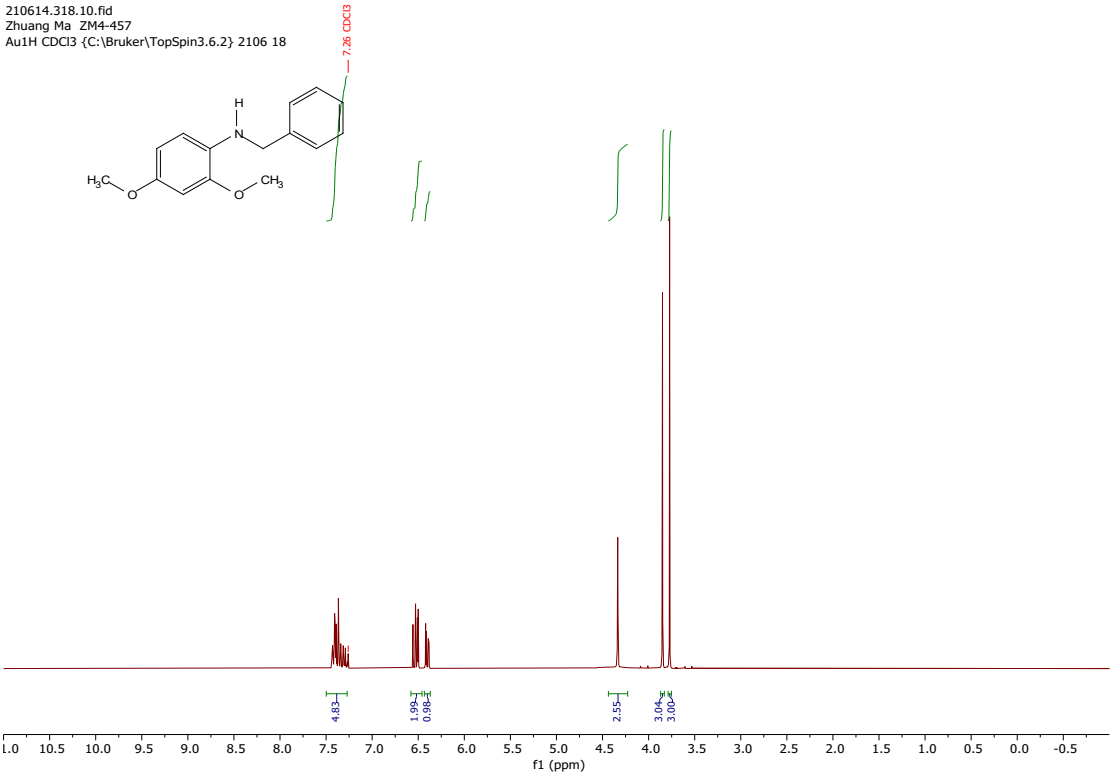


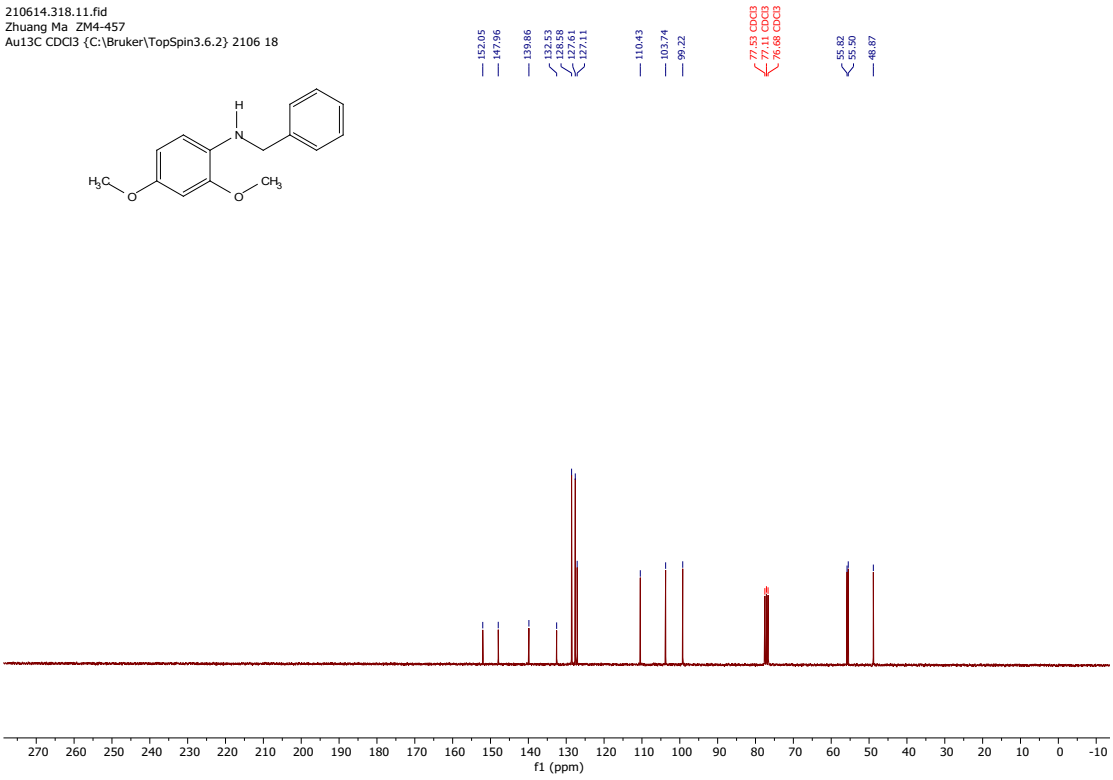
210615.306.11.fid
Zhuang Ma ZM4-454
Au13C CDCl3 {C:\Bruker\TopSpin3.6.2} 2106 6



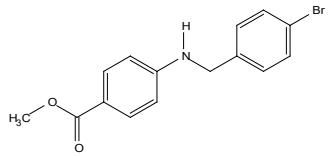
211115.313.10.fid
Zhuang Ma ZM 4-454
Au19F CDCl3 {C:\Bruker\TopSpin3.6.2} 2111 13



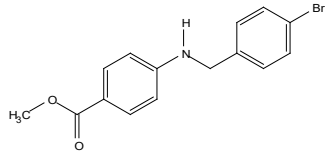

210614.318.10.fid
Zhuang Ma ZM4-457
Au1H CDCl3 {C:\Bruker\TopSpin3.6.2} 2106 18
7.26 CDCl3
H
N
H3C
O
O
CH3
4.83
1.99
0.98
2.55
3.04
3.00
f1 (ppm)

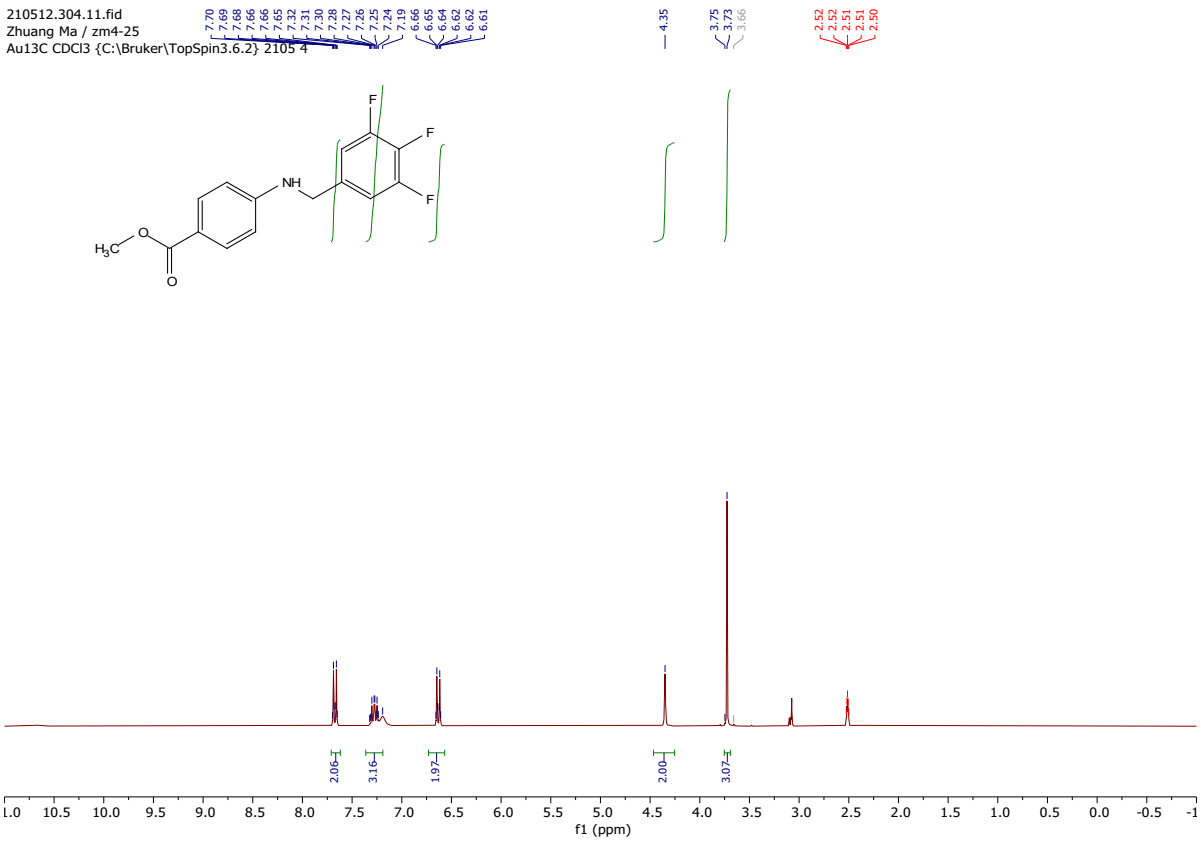

210614.318.11.fid
Zhuang Ma ZM4-457
Au13C CDCl3 {C:\Bruker\TopSpin3.6.2} 2106 18
152.05
147.96
139.86
132.53
128.58
127.61
127.11
110.43
103.74
99.22
77.53 CDCl3
77.11 CDCl3
76.68 CDCl3
55.82
55.50
48.87
H
N
H3C
O
O
CH3
f1 (ppm)

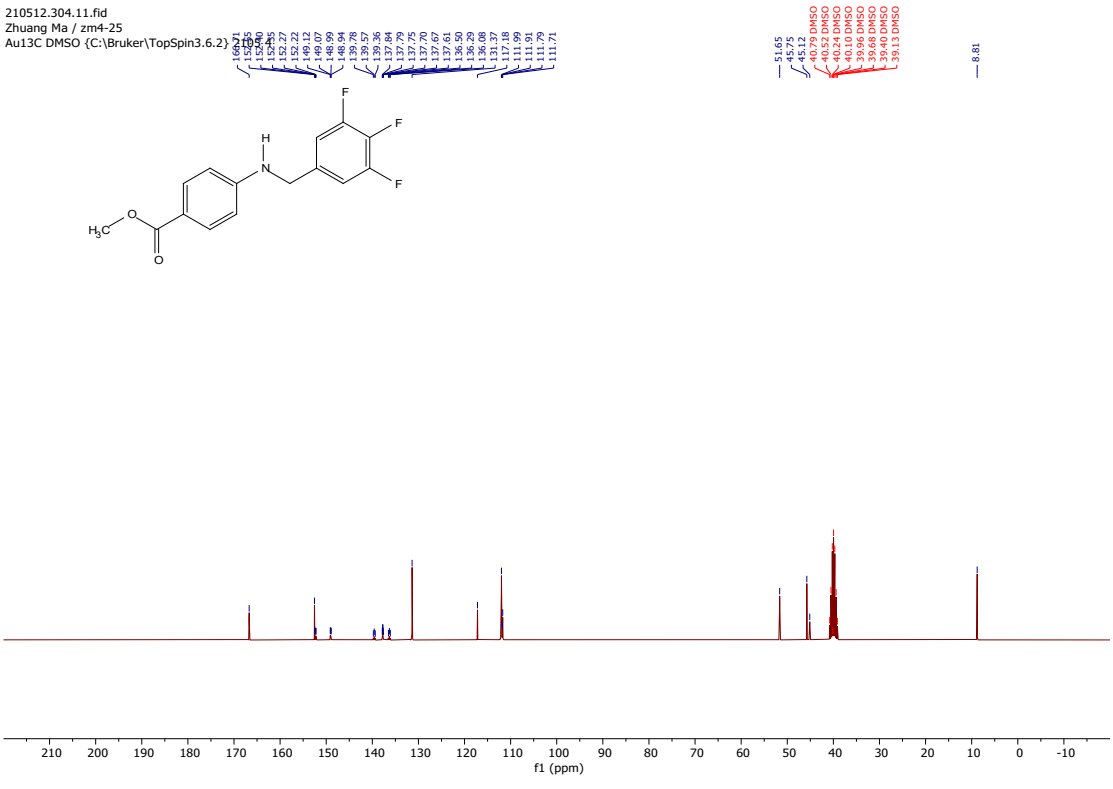
210512.306.10.fid
Zhuang Ma / zm4-23
Au1H CDCl3 {C:\Bruker\TopSpin3.6.2} 2105 6

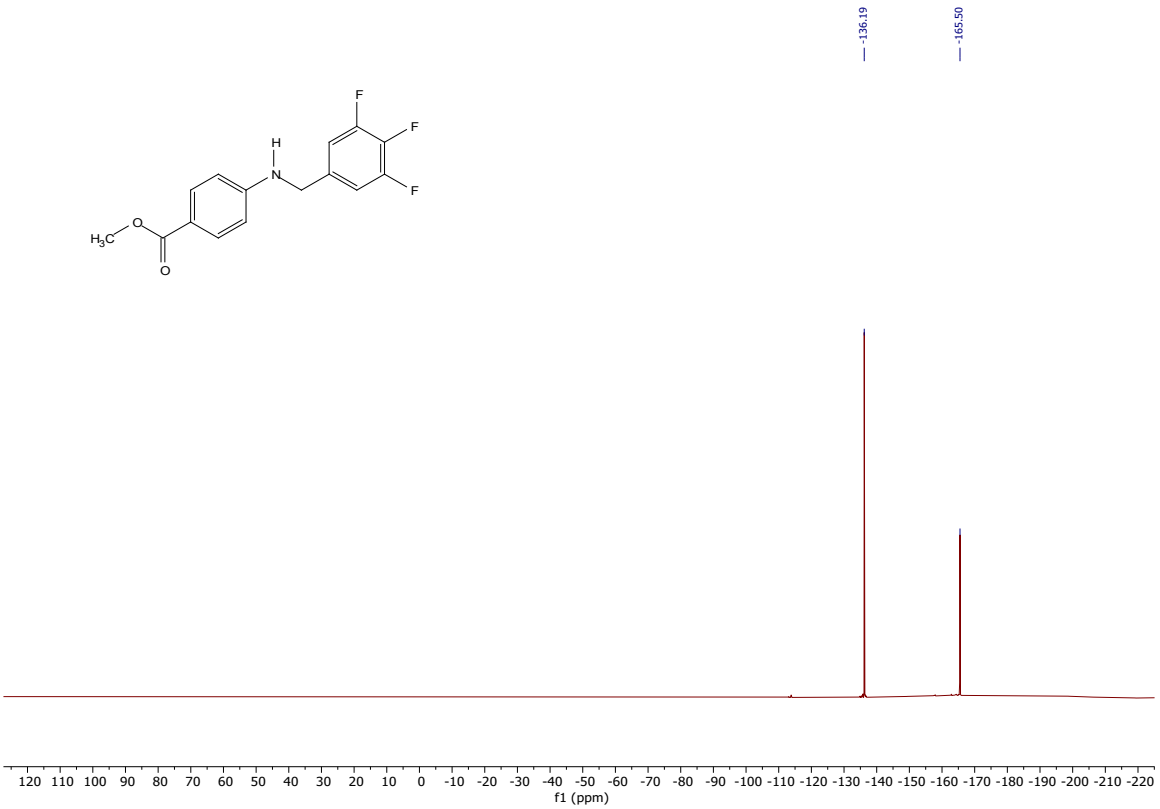


210512.306.11.fid
Zhuang Ma / zm4-23
Au13C CDCl3 {C:\Bruker\TopSpin3.6.2} 2105 6

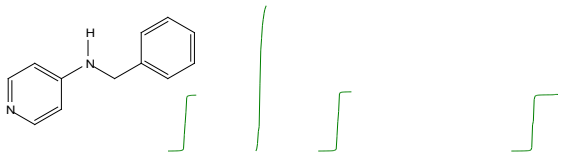


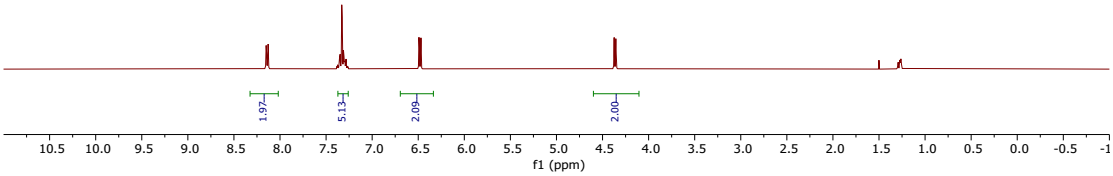

210512.304.11.fid
Zhuang Ma / zm4-25
Au13C CDCl3 {C:\Bruker\TopSpin3.6.2} 2105 4
7.70
7.69
7.68
7.66
7.66
7.65
7.65
7.32
7.31
7.30
7.28
7.27
7.26
7.25
7.24
7.19
6.66
6.65
6.64
6.62
6.62
6.61
4.35
3.75
3.73
3.66
2.52
2.52
2.51
2.51
2.50
F
F
F
NH
O
H_3C
O
2.06
3.16
1.97
2.00
3.07
f1 (ppm)


210512.304.11.fid
Zhuang Ma / zm4-25
Au13C DMSO {C:\Bruker\TopSpin3.6.2} 2104
51.65
45.75
45.12
40.72 DMSO
40.52 DMSO
40.24 DMSO
40.10 DMSO
39.96 DMSO
39.68 DMSO
39.40 DMSO
39.13 DMSO
8.81
F
F
F
H
N
O
H_3C
O
f1 (ppm)


F
F
F
H
N
O
H_3C
O
-136.19
-165.50
120 110 100 90 80 70 60 50 40 30 20 10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210 -220
f1 (ppm)

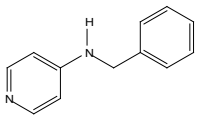
200527.338.11.fid
Zhuang Ma ZM 4-190
Au1H CDCl3 {C:\Bruker\TopSpin3.6.0} 2005 38

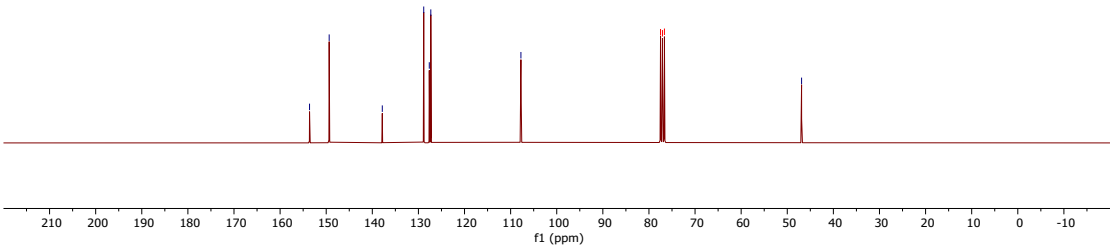




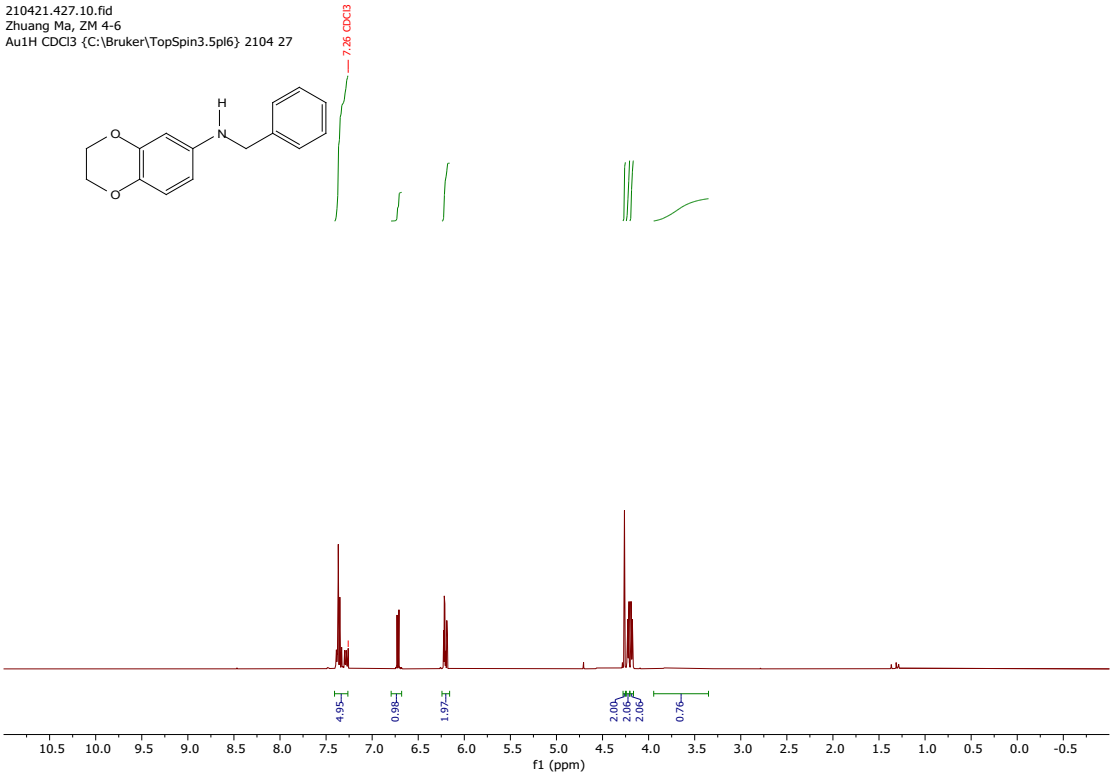
200527.338.11.fid
Zhuang Ma ZM 4-190
Au1H CDCl3 {C:\Bruker\TopSpin3.6.0} 2005 38

153.61
149.35
137.83
128.85
127.64
127.31
107.77
77.49
77.07
76.64
46.90

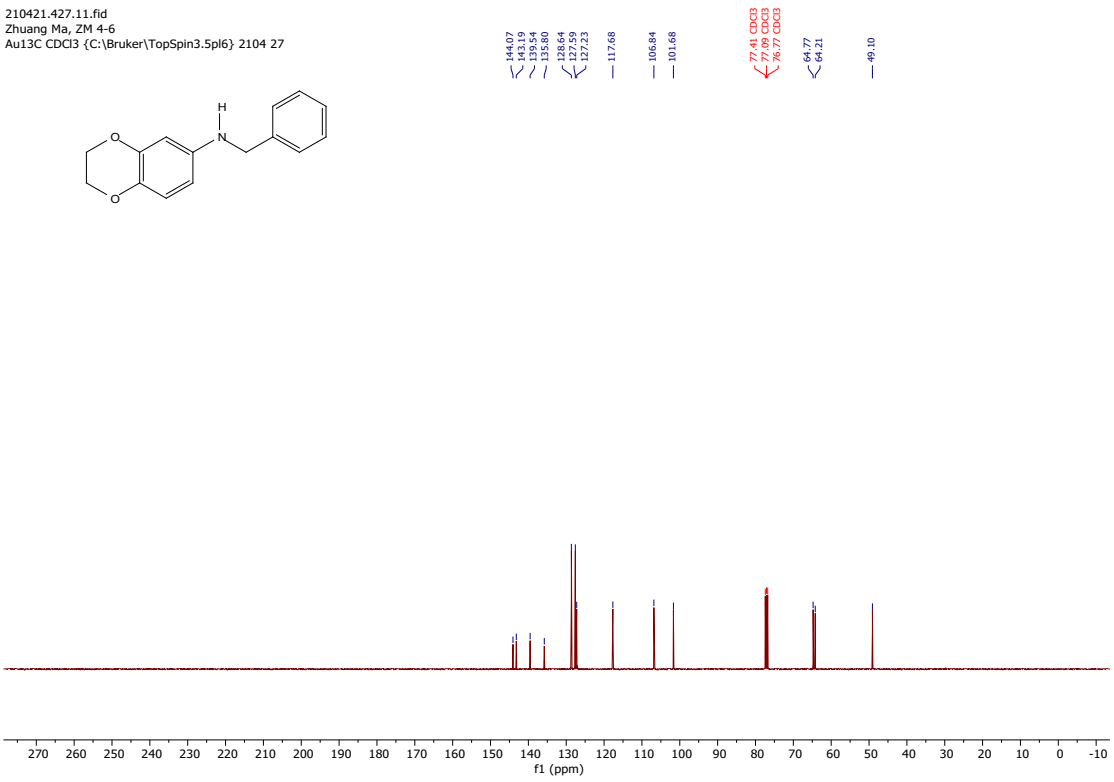


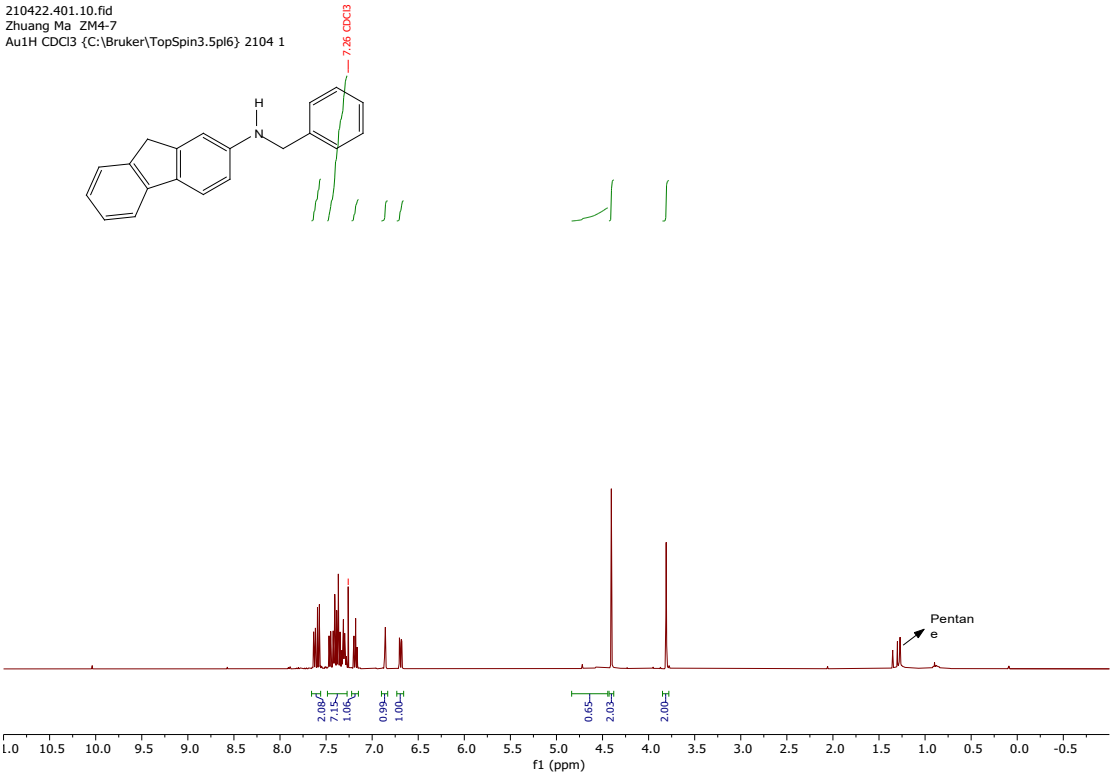


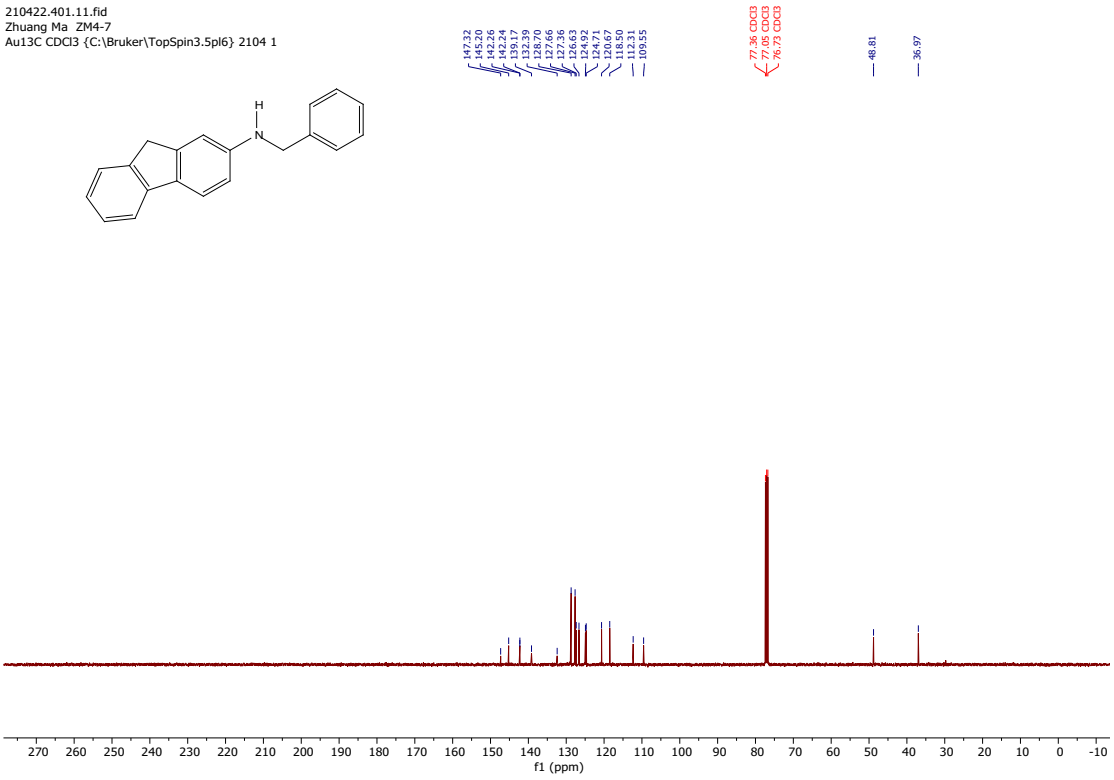
210421.427.10.fid
Zhuang Ma, ZM 4-6
Au1H CDCl3 {C:\Bruker\TopSpin3.5pl6} 2104 27



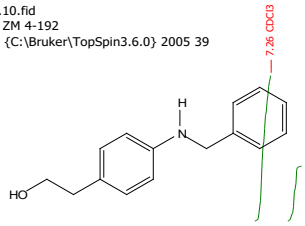
210421.427.11.fid
Zhuang Ma, ZM 4-6
Au13C CDCl3 {C:\Bruker\TopSpin3.5pl6} 2104 27



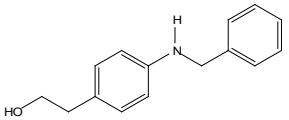

210422.401.10.fid
Zhuang Ma ZM4-7
Au1H CDCl3 {C:\Bruker\TopSpin3.5pl6} 2104 1
7.26 CDCl3
H
N
Pentan
e
2.09
7.15
1.06
0.99
1.00
0.65
2.03
2.00
f1 (ppm)


210422.401.11.fid
Zhuang Ma ZM4-7
Au13C CDCl3 {C:\Bruker\TopSpin3.5pl6} 2104 1
147.32
145.20
142.26
142.24
139.17
132.39
128.70
127.66
127.36
126.63
124.92
124.71
120.67
118.50
113.31
105.55
77.36 CDCl3
77.05 CDCl3
76.73 CDCl3
48.81
36.97
H
N
f1 (ppm)

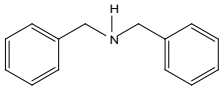
200527.339.10.fid
Zhuang Ma ZM 4-192
Au1H CDCl3 {C:\Bruker\TopSpin3.6.0} 2005 39



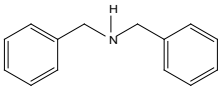
200527.339.11.fid
Zhuang Ma ZM 4-192
Au13C CDCl3 {C:\Bruker\TopSpin3.6.0} 2005 39



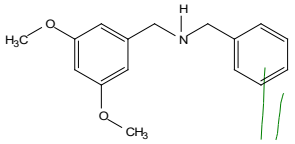
210422.403.10.fid
Zhuang Ma ZM4-109
Au1H CDCl3 {C:\Bruker\TopSpin3.5pl6} 2104 3

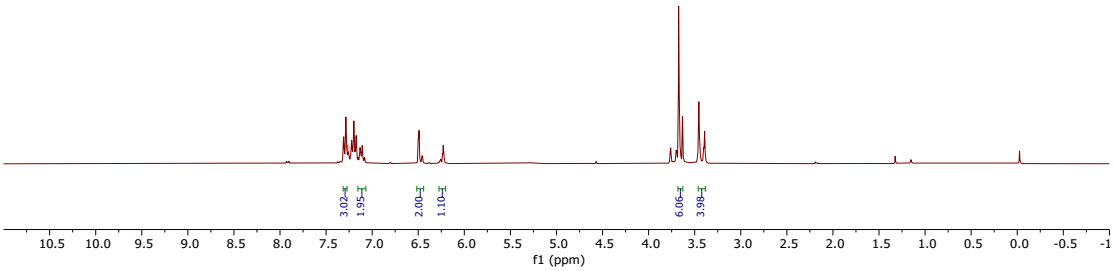


210422.403.11.fid
Zhuang Ma ZM4-109
Au13C CDCl3 {C:\Bruker\TopSpin3.5pl6} 2104 3

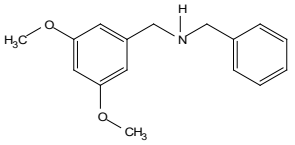


200608.f380.10.fid
Ma/ ZM4-143
PROTON CDCl3 {C:\Bruker\TopSpin3.6.0} 2006 20

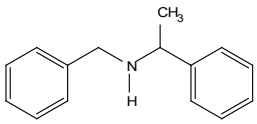




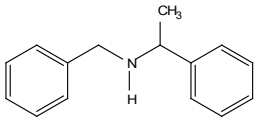
200608.f380.11.fid
Ma/ ZM4-143
C13CPD CDCl3 {C:\Bruker\TopSpin3.6.0} 2006 20

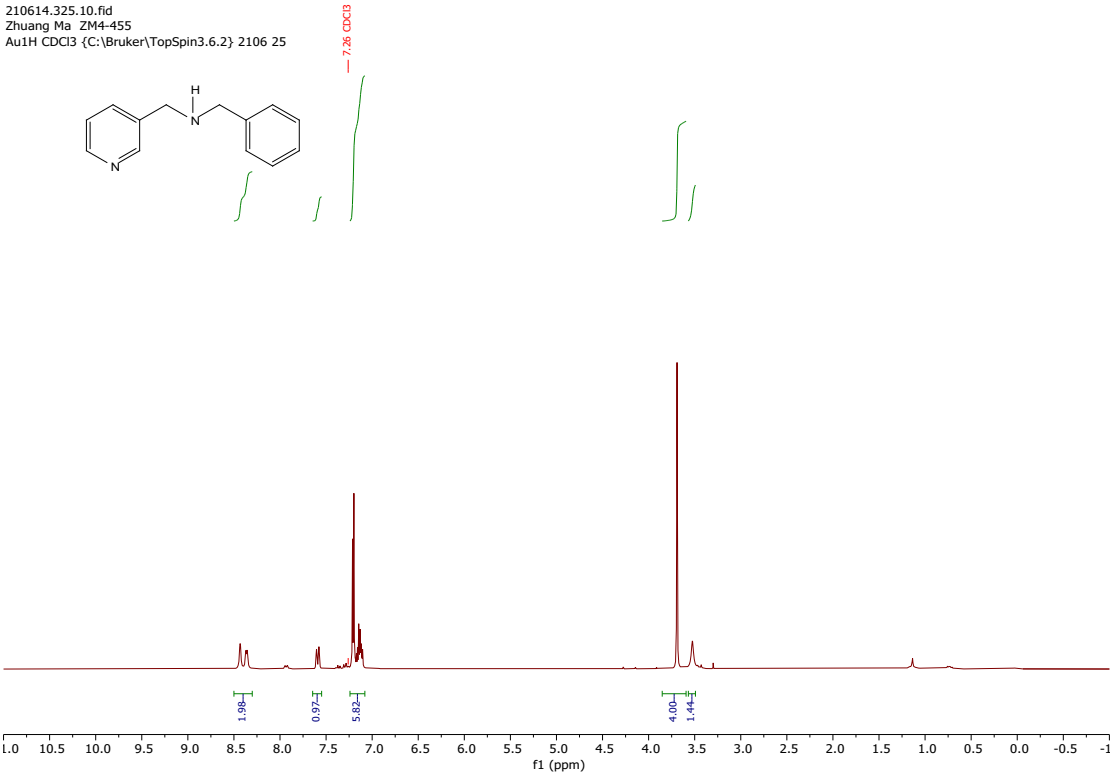


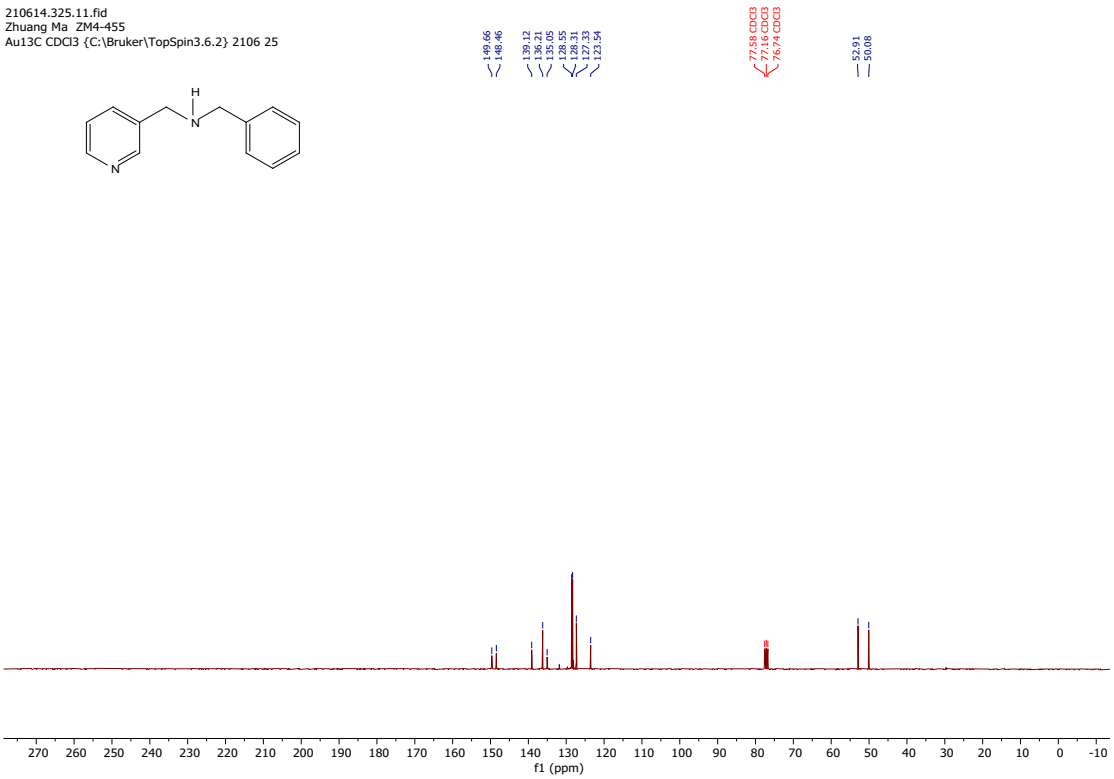
210617.319.10.fid
Zhuang Ma ZM4-469
Au1H CDCl3 {C:\Bruker\TopSpin3.6.2} 2106 19



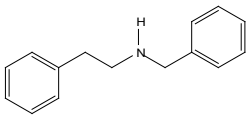
210617.319.11.fid
Zhuang Ma ZM4-469
Au13C CDCl3 {C:\Bruker\TopSpin3.6.2} 2106 19



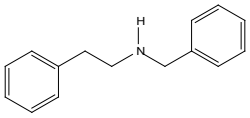

210614.325.10.fid
Zhuang Ma ZM4-455
Au1H CDCl3 {C:\Bruker\TopSpin3.6.2} 2106 25
7.26 CDCl3
H
N
N
1.98
0.97
5.82
4.00
1.44
f1 (ppm)


210614.325.11.fid
Zhuang Ma ZM4-455
Au13C CDCl3 {C:\Bruker\TopSpin3.6.2} 2106 25
149.66
148.46
139.12
136.21
135.05
128.55
128.31
127.33
123.54
77.58 CDCl3
77.16 CDCl3
76.74 CDCl3
52.91
50.08
H
N
N
f1 (ppm)

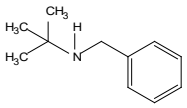
200522.311.10.fid
Zhuang Ma, zm 4-186
Au1H CDCl3 {C:\Bruker\TopSpin3.6.0} 2005 11



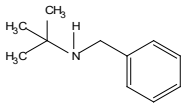
200522.311.11.fid
Zhuang Ma, zm 4-186
Au13C CDCl3 {C:\Bruker\TopSpin3.6.0} 2005 11



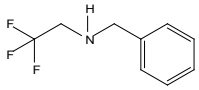
200603.f363.10.fid
Zhuang Ma ZM4-193
PROTON CDCl3 {C:\Bruker\TopSpin3.6.0} 2006 3



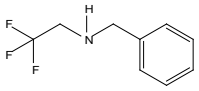
200603.f363.11.fid
Zhuang Ma ZM4-193
C13CPD CDCl3 {C:\Bruker\TopSpin3.6.0} 2006 3



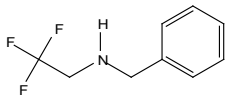
210420.f327.10.fid
Zhuang Ma ZM4-199
PROTON CDCl3 {C:\Bruker\TopSpin3.6.2} 2104 27



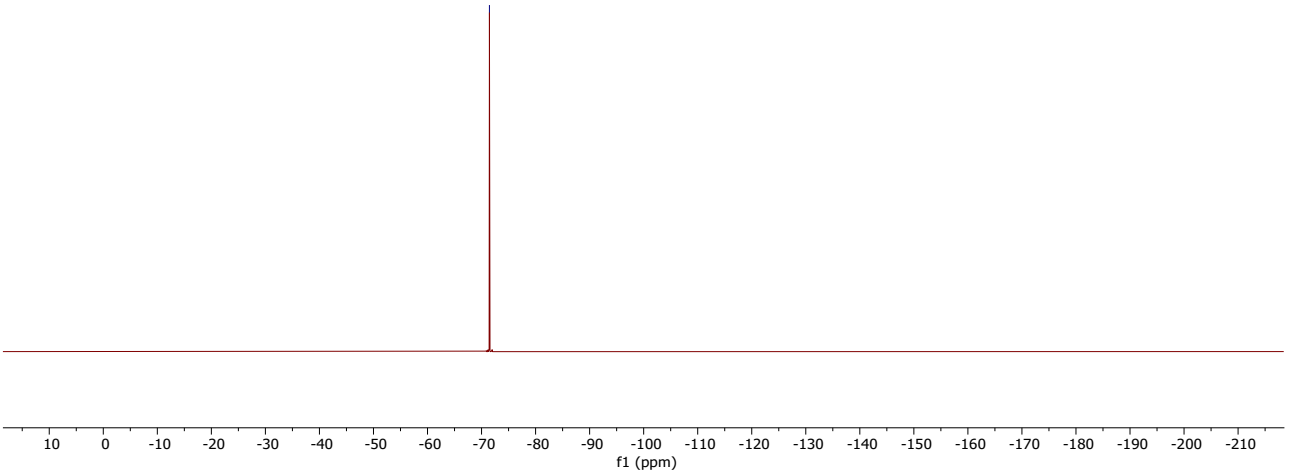
210420.f327.11.fid
Zhuang Ma ZM4-199
C13CPD CDCl3 {C:\Bruker\TopSpin3.6.2} 2104 27

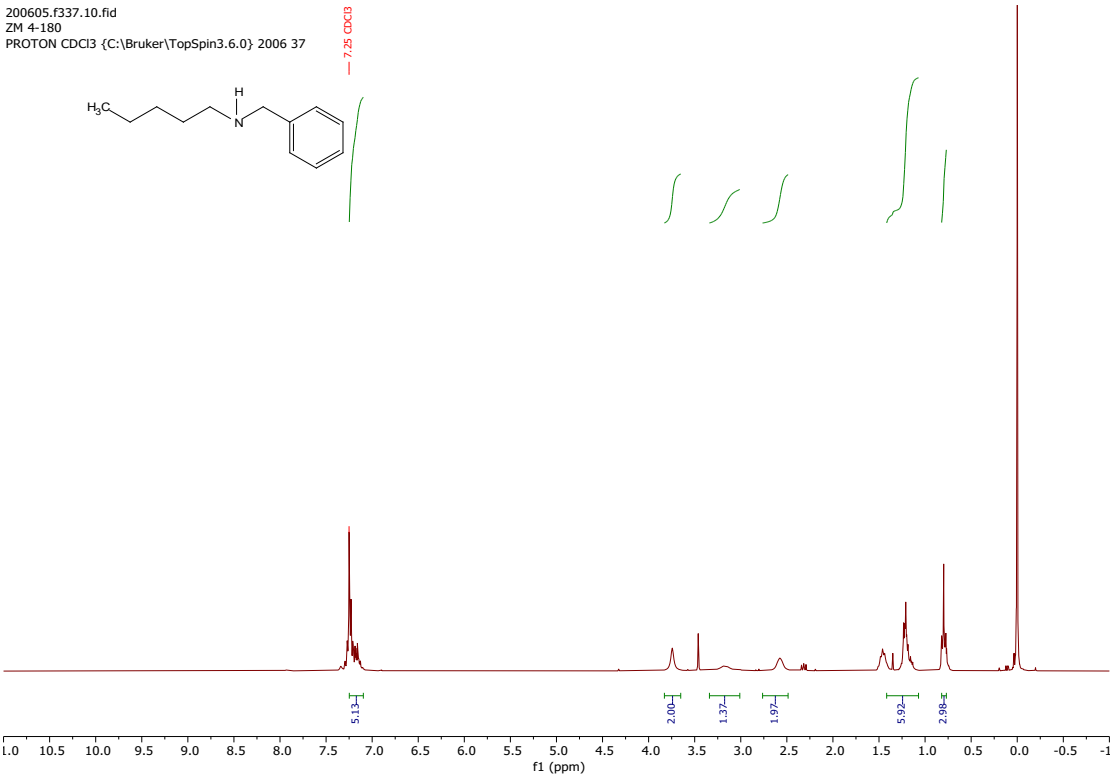


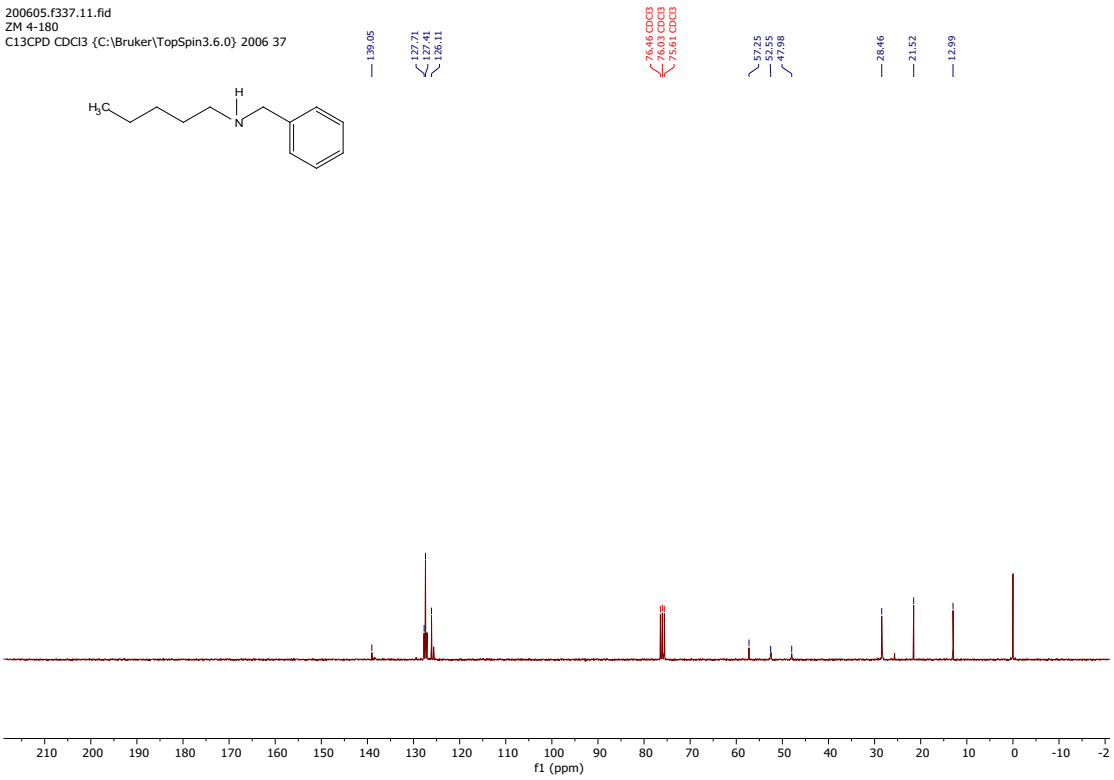
210423.444.10.fid
Zhuang Ma ZM4-199
F19 CDCl3 {C:\Bruker\TopSpin3.5pl6} 2104 44

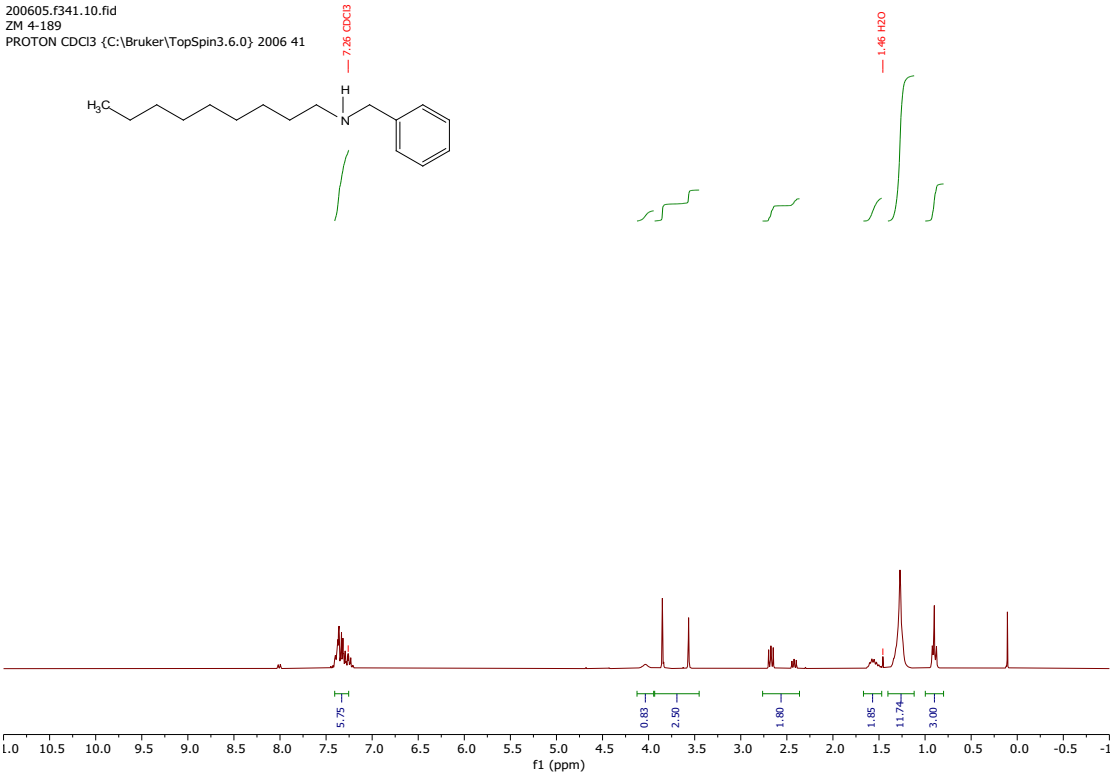


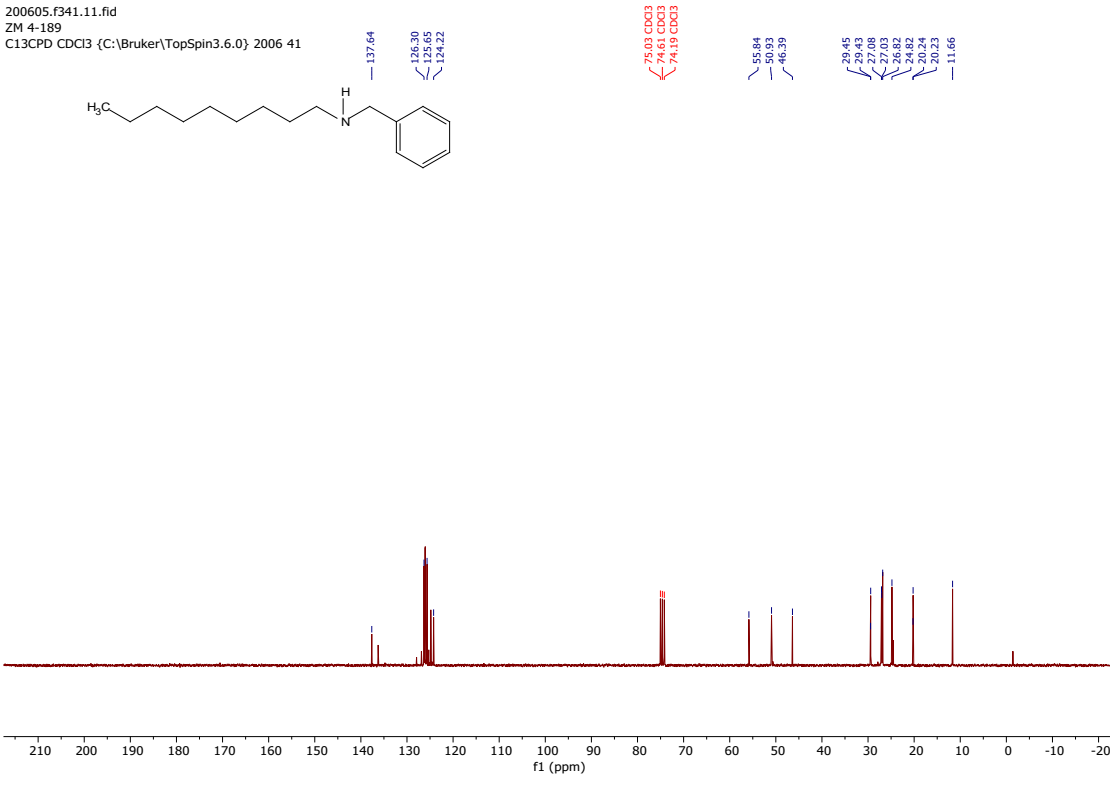
-71.46



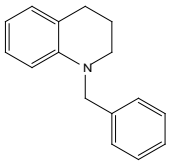

200605.f337.10.fid
ZM 4-180
PROTON CDCl3 {C:\Bruker\TopSpin3.6.0} 2006 37
7.25 CDCl3
H3C
H
N
5.13
2.00
1.37
1.97
5.92
2.98
f1 (ppm)


200605.f337.11.fid
ZM 4-180
C13CPD CDCl3 {C:\Bruker\TopSpin3.6.0} 2006 37
139.05
127.71
127.41
126.11
76.46 CDCl3
76.03 CDCl3
75.61 CDCl3
57.25
52.55
47.98
28.46
21.52
12.99
H3C
H
N
f1 (ppm)

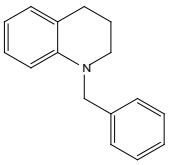

200605.f341.10.fid
ZM 4-189
PROTON CDCl3 {C:\Bruker\TopSpin3.6.0} 2006 41
7.26 CDCl3
1.46 H2O
H3C
H
N
5.75
0.83
2.50
1.80
1.85
11.74
3.00
f1 (ppm)

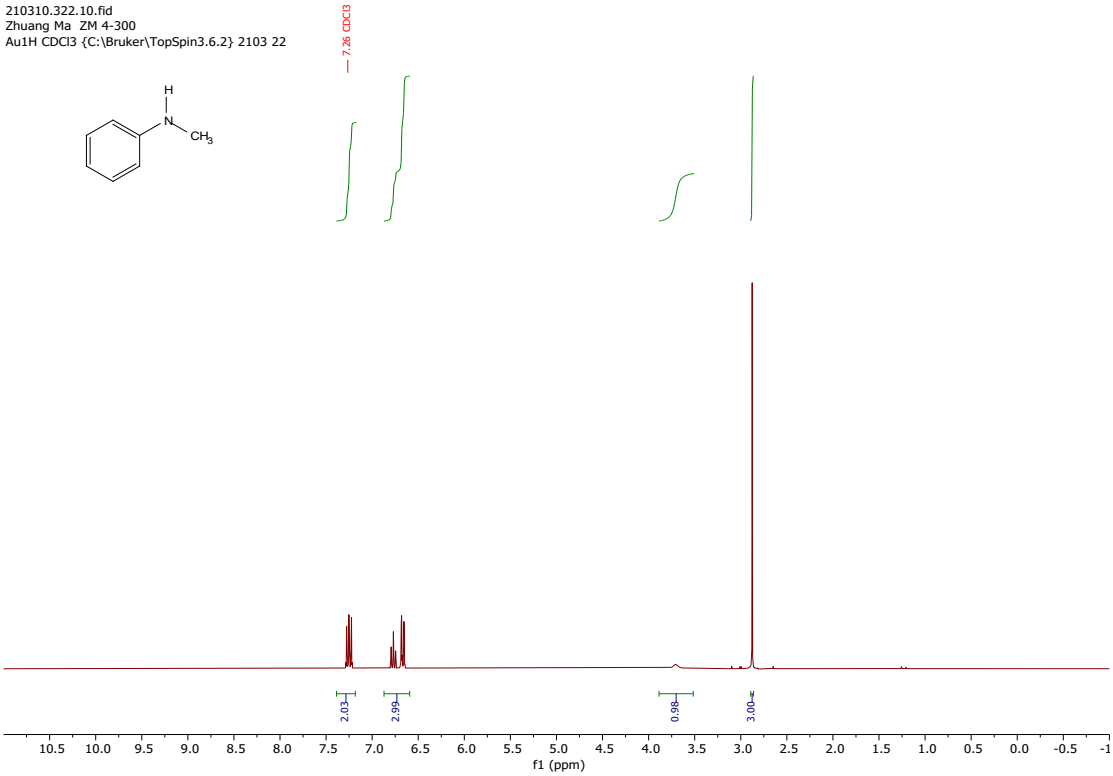

200605.f341.11.fid
ZM 4-189
C13CPD CDCl3 {C:\Bruker\TopSpin3.6.0} 2006 41
137.64
126.30
125.65
124.22
75.03 CDCl3
74.61 CDCl3
74.19 CDCl3
55.84
50.93
46.39
29.45
29.43
27.08
27.03
26.82
24.82
20.24
20.23
11.66
H3C
H
N
f1 (ppm)

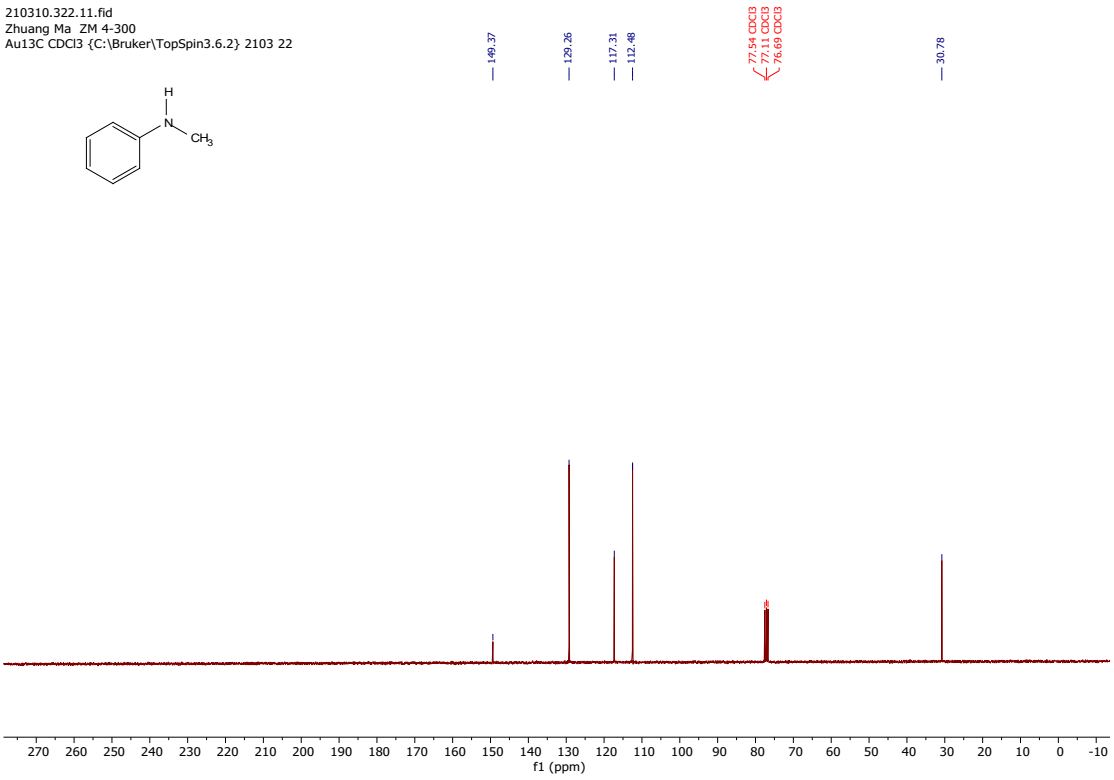
210429.415.10.fid
Zhuang Ma ZM 4-224
Au1H CDCl3 {C:\Bruker\TopSpin3.5pl6} 2104 15



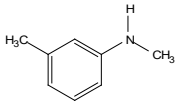
210429.415.11.fid
Zhuang Ma ZM 4-224
Au13C CDCl3 {C:\Bruker\TopSpin3.5pl6} 2104 15



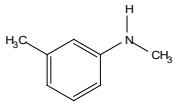

210310.322.10.fid
Zhuang Ma ZM 4-300
Au1H CDCl3 {C:\Bruker\TopSpin3.6.2} 2103 22
7.26 CDCl3
H
N
CH3
2.03
2.99
0.98
3.00
10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)


210310.322.11.fid
Zhuang Ma ZM 4-300
Au13C CDCl3 {C:\Bruker\TopSpin3.6.2} 2103 22
149.37
129.26
117.31
112.48
77.54 CDCl3
77.11 CDCl3
76.69 CDCl3
30.78
H
N
CH3
270 260 250 240 230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

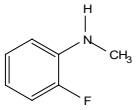
210614.322.10.fid
Zhuang Ma ZM4-314
Au1H CDCl3 {C:\Bruker\TopSpin3.6.2} 2106 22



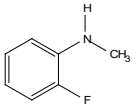
210614.322.11.fid
Zhuang Ma ZM4-314
Au13C CDCl3 {C:\Bruker\TopSpin3.6.2} 2106 22



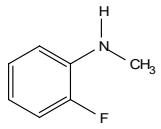
210520.415.10.fid
Ma/ ZM4-316
Au1H DMSO {C:\Bruker\TopSpin3.5pl6} 2105 15



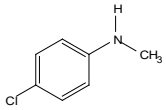
210520.415.11.fid
Ma/ ZM4-316
Au13C DMSO {C:\Bruker\TopSpin3.5pl6} 2105 15



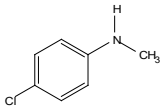
210520.415.12.fid
Ma/ ZM4-316
F19 DMSO {C:\Bruker\TopSpin3.5pl6} 2105 15

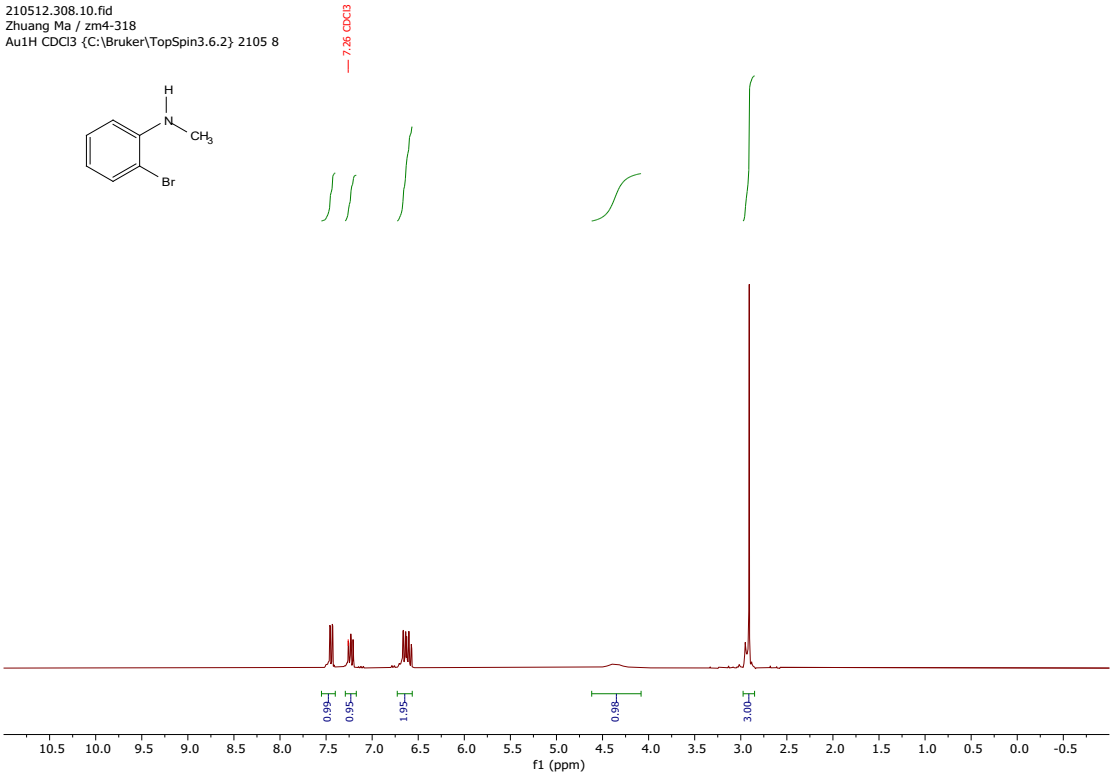


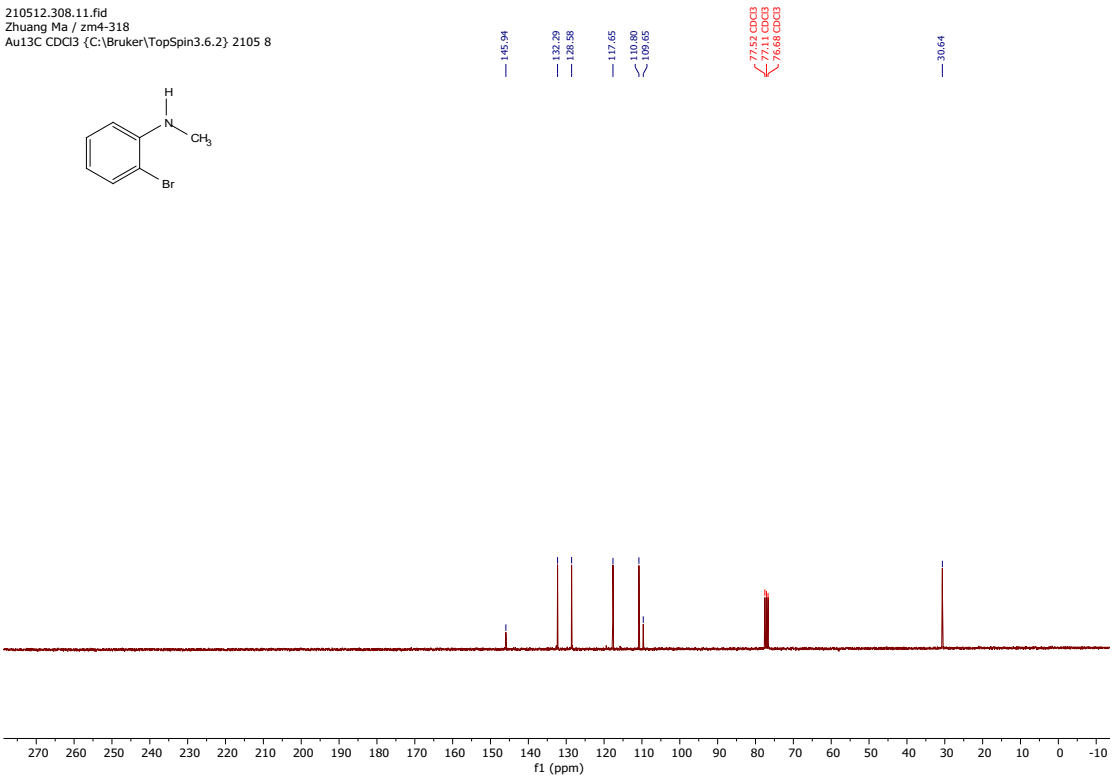
210422.402.10.fid
Zhuang Ma ZM4-315
Au1H CDCl3 {C:\Bruker\TopSpin3.5pl6} 2104 2



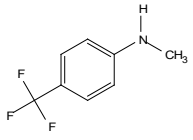
210422.402.11.fid
Zhuang Ma ZM4-315
Au13C CDCl3 {C:\Bruker\TopSpin3.5pl6} 2104 2



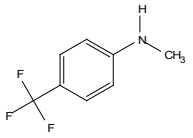

210512.308.10.fid
Zhuang Ma / zm4-318
Au1H CDCl3 {C:\Bruker\TopSpin3.6.2} 2105 8
7.26 CDCl3
H
N
CH3
Br
0.99
0.95
1.95
0.98
3.00
10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)


210512.308.11.fid
Zhuang Ma / zm4-318
Au13C CDCl3 {C:\Bruker\TopSpin3.6.2} 2105 8
145.94
132.29
128.58
117.65
110.80
109.65
77.52 CDCl3
77.11 CDCl3
76.68 CDCl3
30.64
H
N
CH3
Br
270 260 250 240 230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

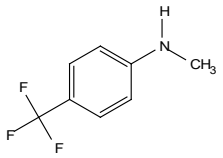
210614.324.10.fid
Zhuang Ma ZM4-312
Au1H CDCl3 {C:\Bruker\TopSpin3.6.2} 2106 24

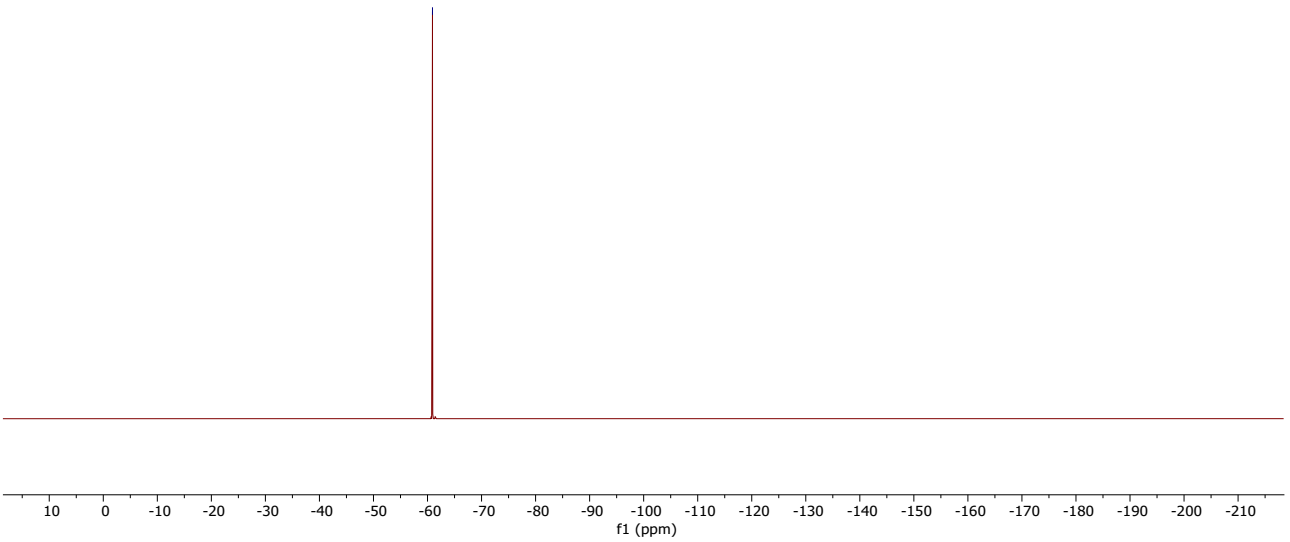


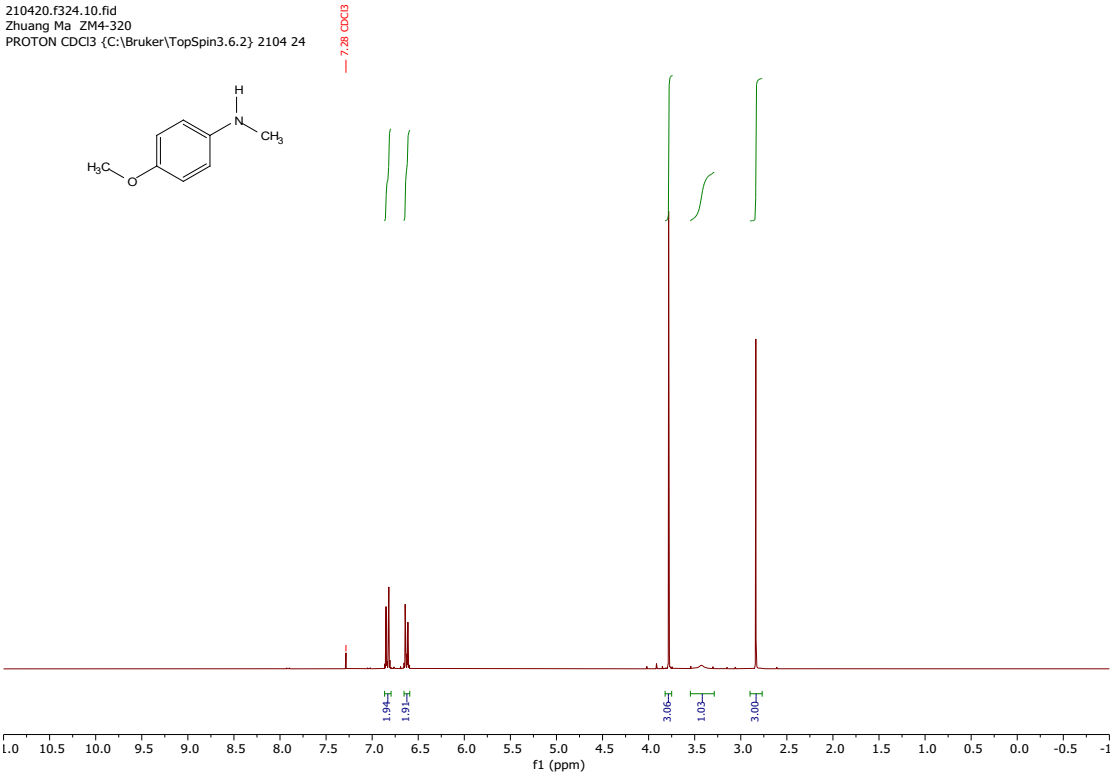
210614.324.11.fid
Zhuang Ma ZM4-312
Au13C CDCl3 {C:\Bruker\TopSpin3.6.2} 2106 24

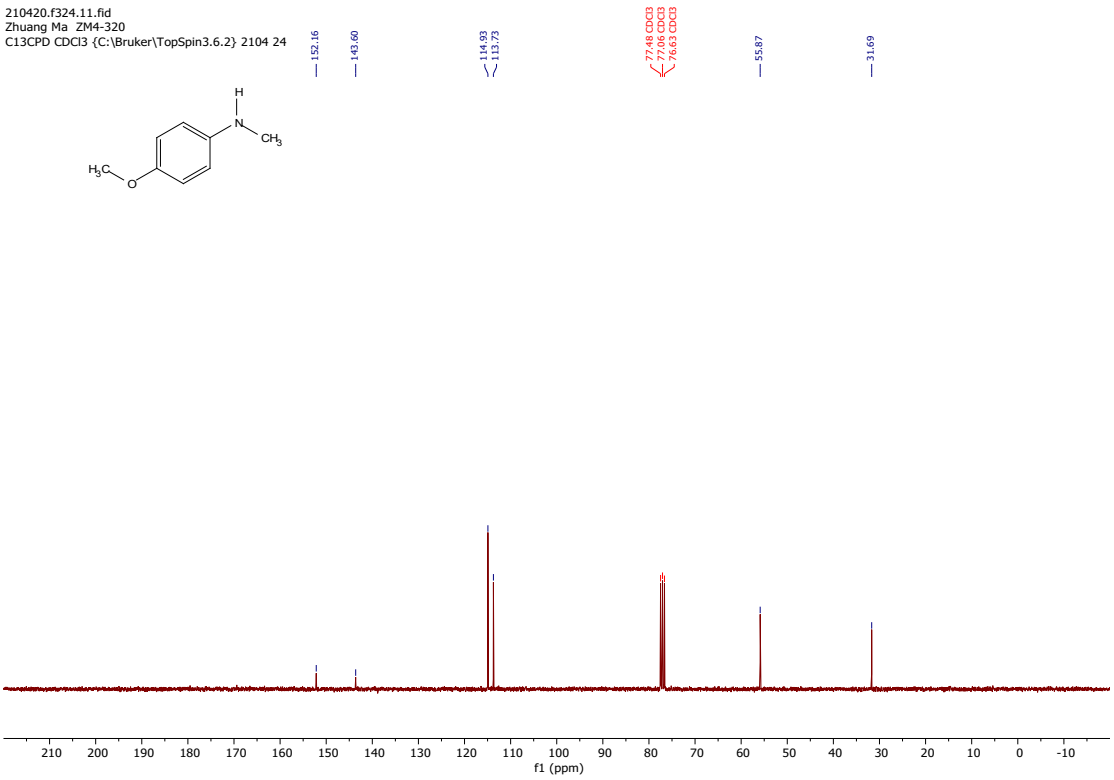


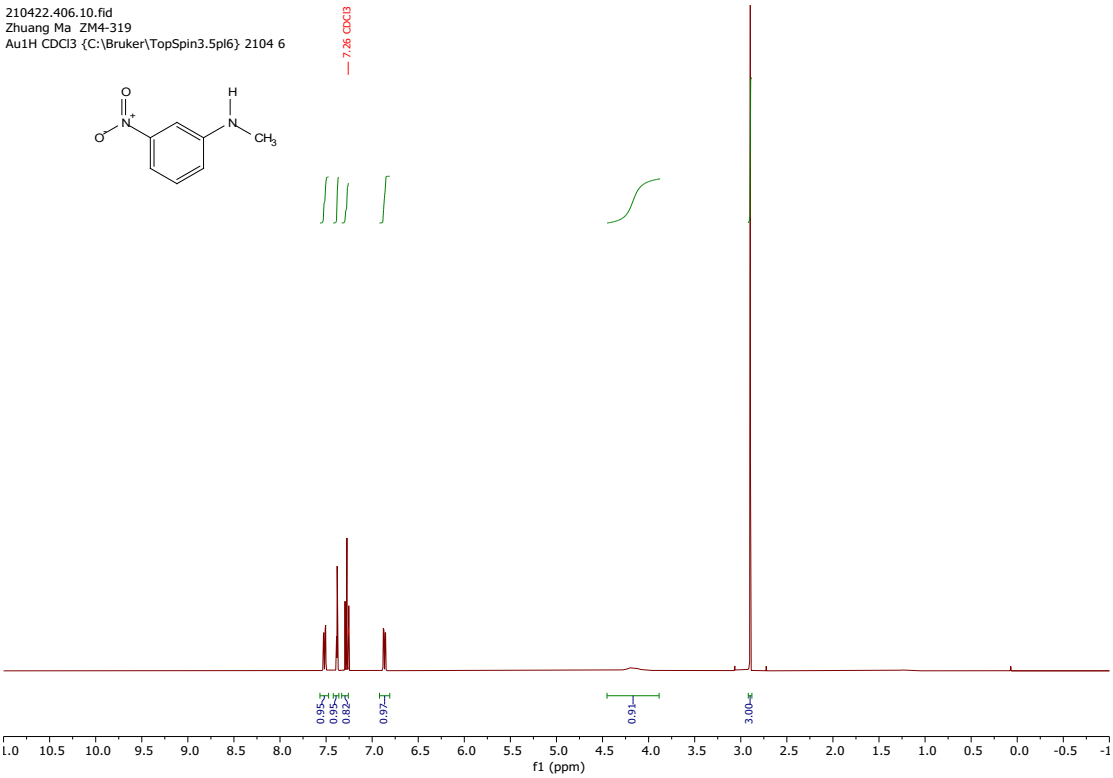
210615.434.10.fid
Zhuang Ma ZM4-312
F19 CDCl3 {C:\Bruker\TopSpin3.5pl6} 2106 34

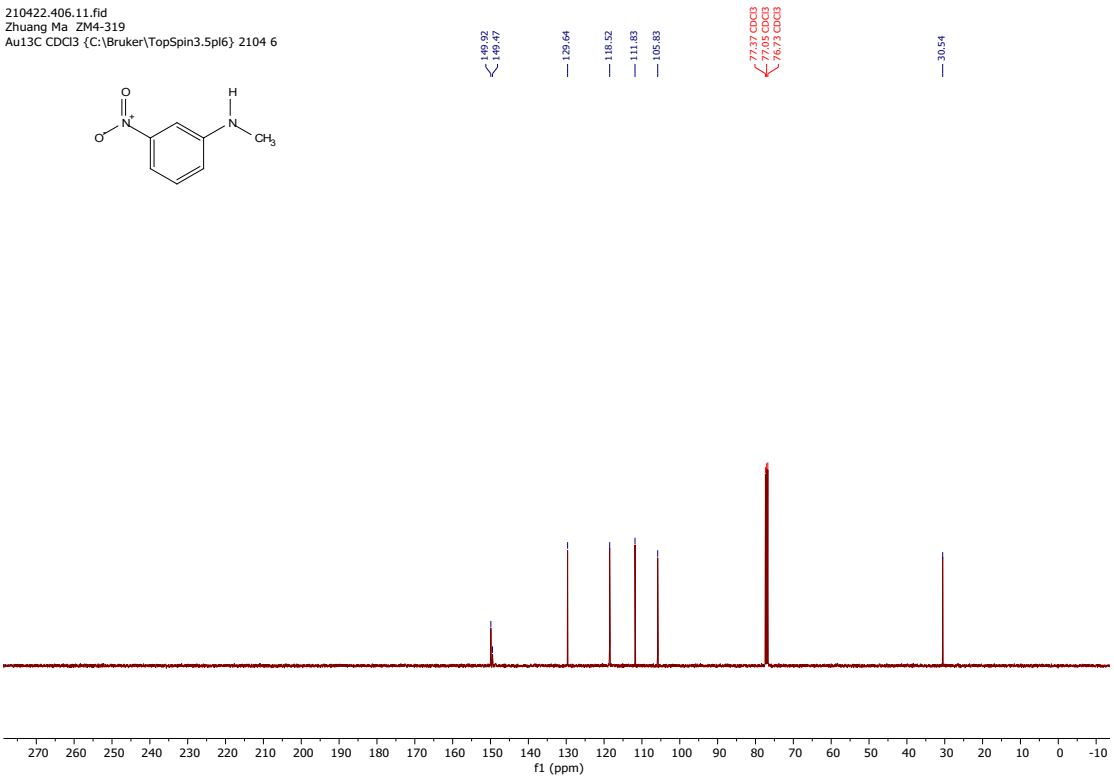


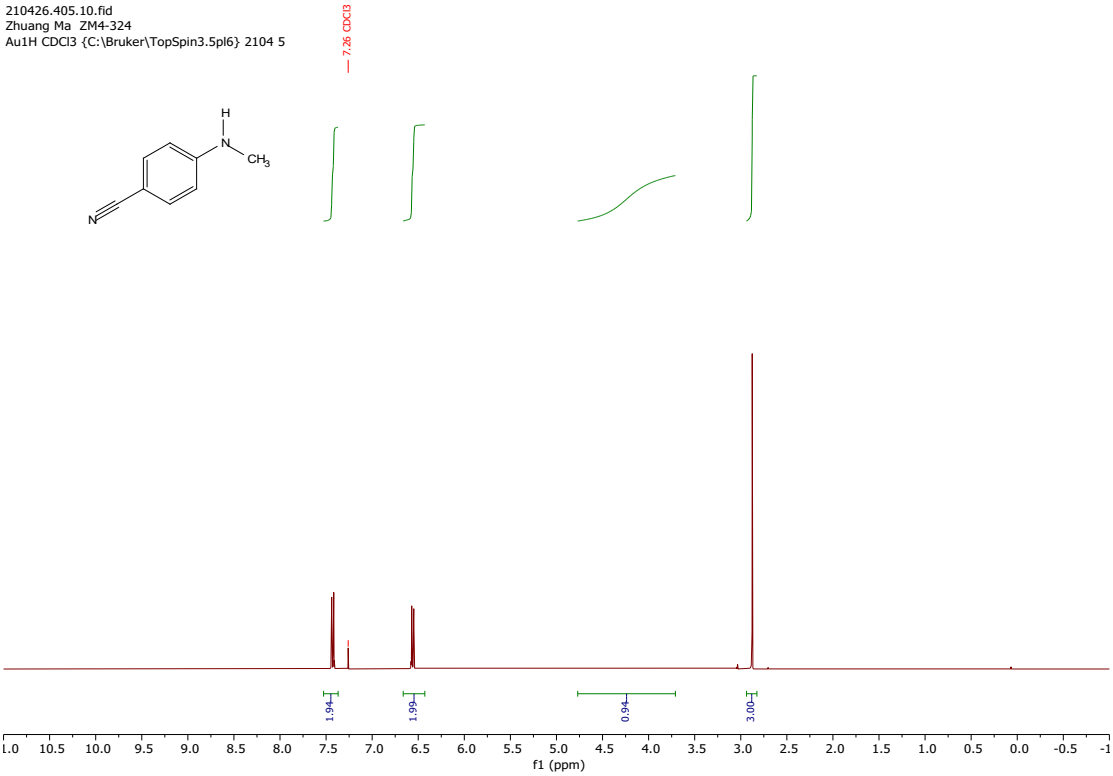


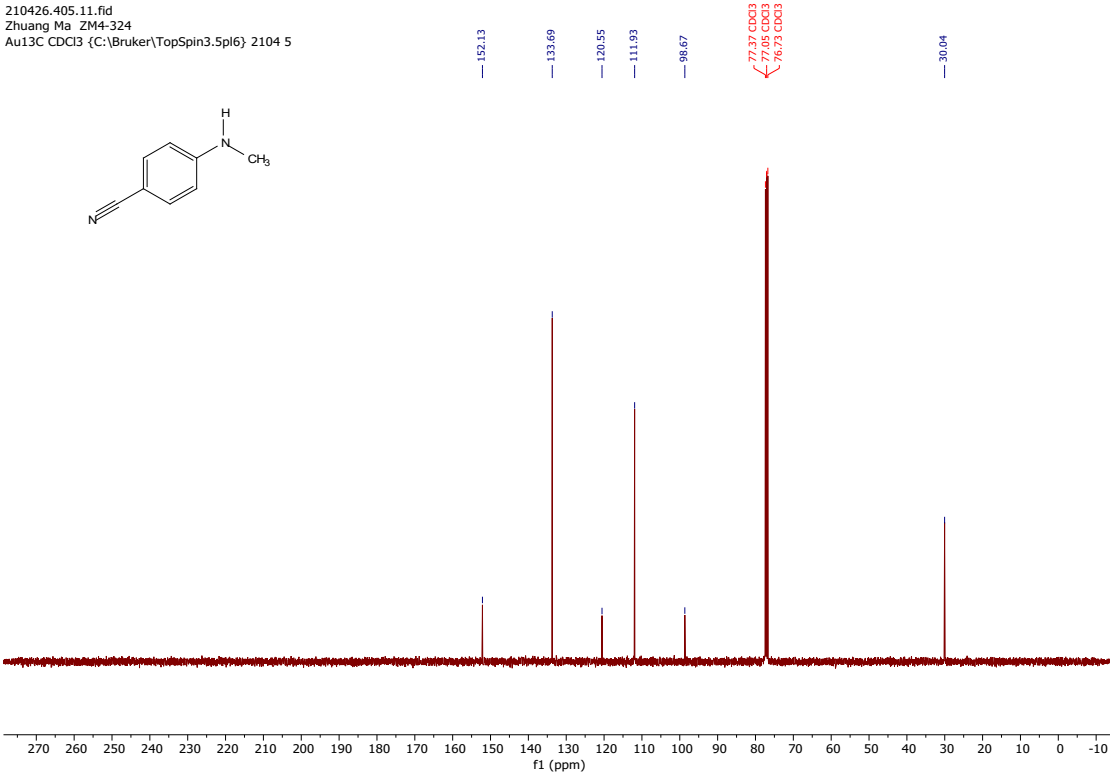

210420.f324.10.fid
Zhuang Ma ZM4-320
PROTON CDCl3 {C:\Bruker\TopSpin3.6.2} 2104 24
7.26 CDCl3
H
N
CH3
H3C
O
1.94
1.91
3.06
1.03
3.00
f1 (ppm)


210420.f324.11.fid
Zhuang Ma ZM4-320
C13CPD CDCl3 {C:\Bruker\TopSpin3.6.2} 2104 24
152.16
143.60
114.93
113.73
77.48 CDCl3
77.06 CDCl3
76.63 CDCl3
55.87
31.69
H
N
CH3
H3C
O
f1 (ppm)

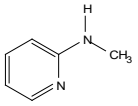

210422.406.10.fid
Zhuang Ma ZM4-319
Au1H CDCl3 {C:\Bruker\TopSpin3.5pl6} 2104 6
7.26 CDCl3
0.95
0.95
0.82
0.97
0.91
3.00
f1 (ppm)


210422.406.11.fid
Zhuang Ma ZM4-319
Au13C CDCl3 {C:\Bruker\TopSpin3.5pl6} 2104 6
149.92
149.47
129.64
118.52
111.83
105.83
77.37 CDCl3
77.05 CDCl3
76.73 CDCl3
30.54
f1 (ppm)

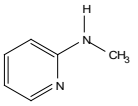

210426.405.10.fid
Zhuang Ma ZM4-324
Au1H CDCl3 {C:\Bruker\TopSpin3.5pl6} 2104 5
7.26 CDCl3
H
N
CH3
N
1.94
1.99
0.94
3.00
f1 (ppm)

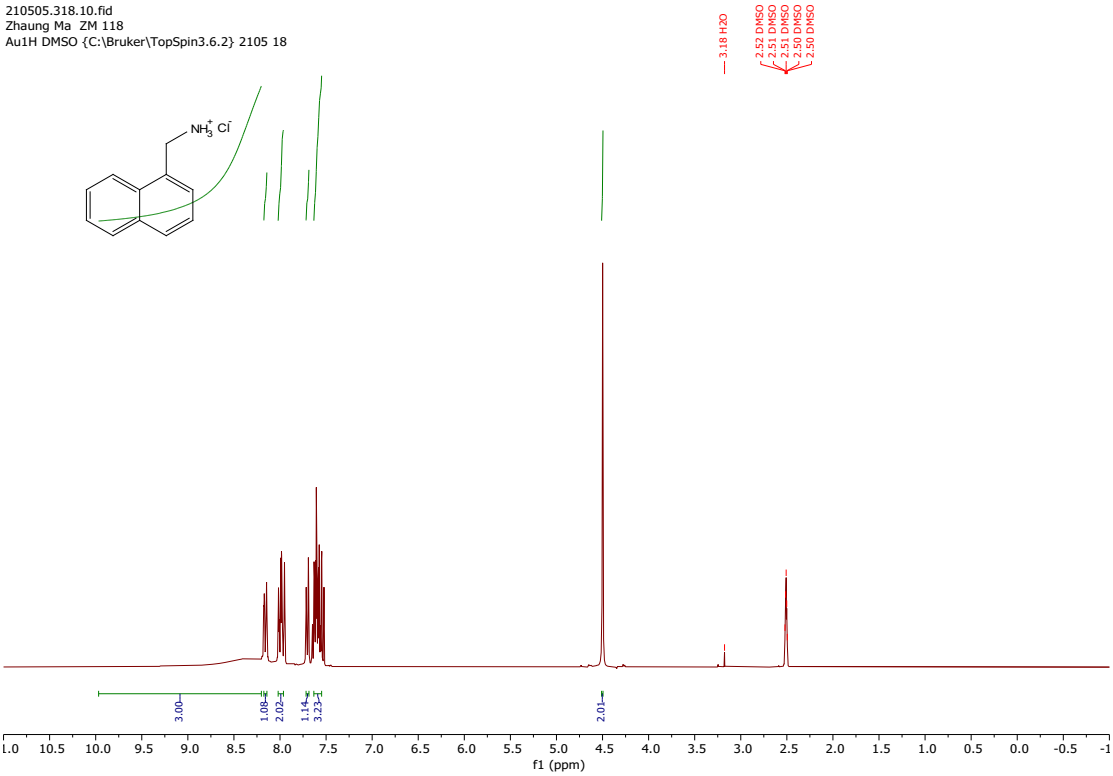

210426.405.11.fid
Zhuang Ma ZM4-324
Au13C CDCl3 {C:\Bruker\TopSpin3.5pl6} 2104 5
152.13
133.69
120.55
111.93
98.67
77.37 CDCl3
77.05 CDCl3
76.73 CDCl3
30.04
H
N
CH3
N
f1 (ppm)

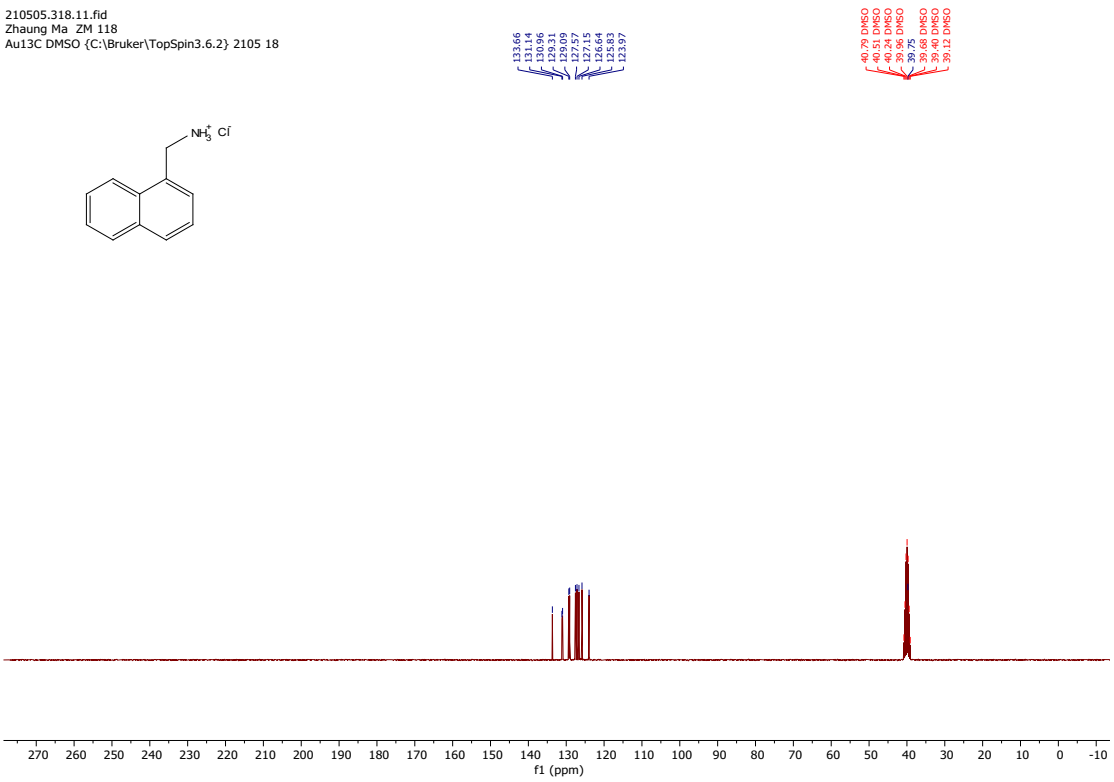
210422.407.10.fid
Zhuang Ma ZM4-317
Au1H CDCl3 {C:\Bruker\TopSpin3.5pl6} 2104 7



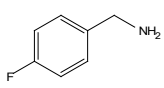
210422.407.11.fid
Zhuang Ma ZM4-317
Au13C CDCl3 {C:\Bruker\TopSpin3.5pl6} 2104 7



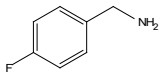

210505.318.10.fid
Zhaung Ma ZM 118
Au1H DMSO {C:\Bruker\TopSpin3.6.2} 2105 18
3.18 H2O
2.52 DMSO
2.51 DMSO
2.51 DMSO
2.50 DMSO
2.50 DMSO
NH3+ Cl-
3.00
1.08
2.02
1.14
3.23
2.01
f1 (ppm)


210505.318.11.fid
Zhaung Ma ZM 118
Au13C DMSO {C:\Bruker\TopSpin3.6.2} 2105 18
133.66
131.14
130.96
129.31
129.09
127.77
127.15
126.64
125.83
123.97
40.79 DMSO
40.51 DMSO
40.24 DMSO
39.96 DMSO
39.68 DMSO
39.40 DMSO
39.12 DMSO
NH3+ Cl-
f1 (ppm)

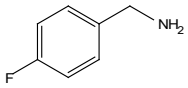
210520.416.10.fid
Ma/ ZM4-410
Au1H DMSO {C:\Bruker\TopSpin3.5pl6} 2105 16



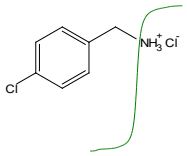
210520.416.11.fid
Ma/ ZM4-410
Au13C DMSO {C:\Bruker\TopSpin3.5pl6} 2105 16



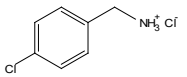
210520.416.12.fid
Ma/ ZM4-410
F19 DMSO {C:\Bruker\TopSpin3.5pl6} 2105 16



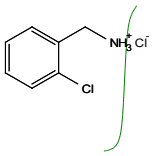
210427.450.11.fid
Zhuang Ma ZM4-404-2
Au1H DMSO {C:\Bruker\TopSpin3.5pl6} 2104 50



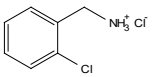
210427.450.11.fid
Zhuang Ma ZM4-404-2
Au13C DMSO {C:\Bruker\TopSpin3.5pl6} 2104 50



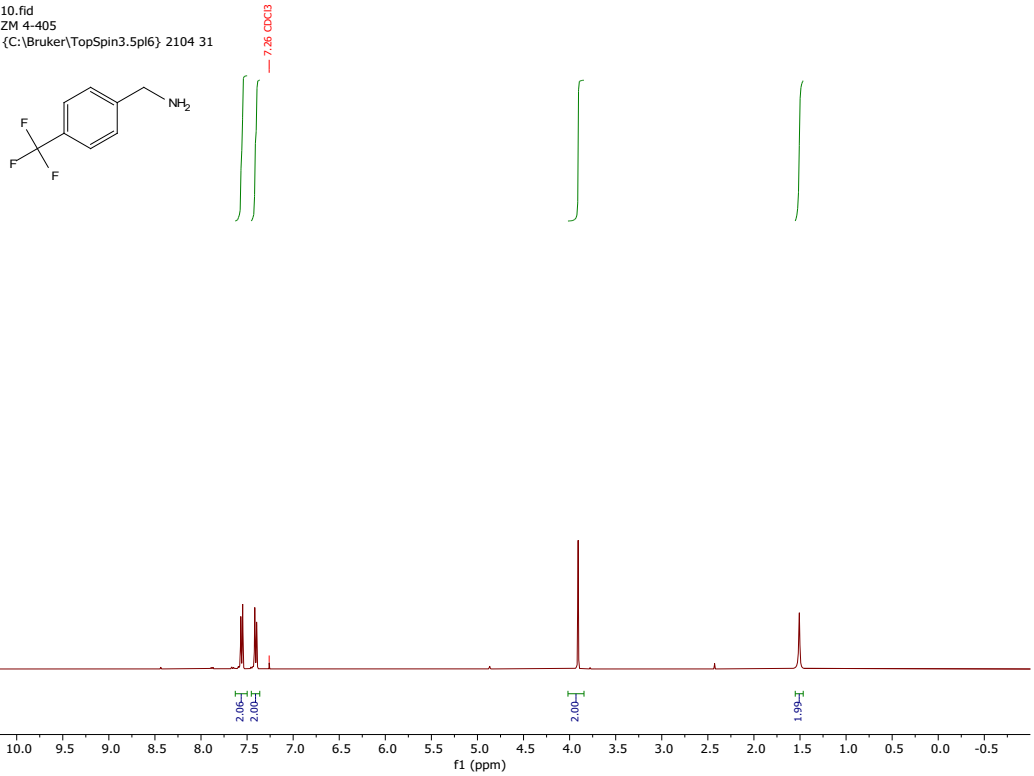
210427.446.11.fid
Zhuang Ma ZM4-413
Au1H DMSO {C:\Bruker\TopSpin3.5pl6} 2104 46



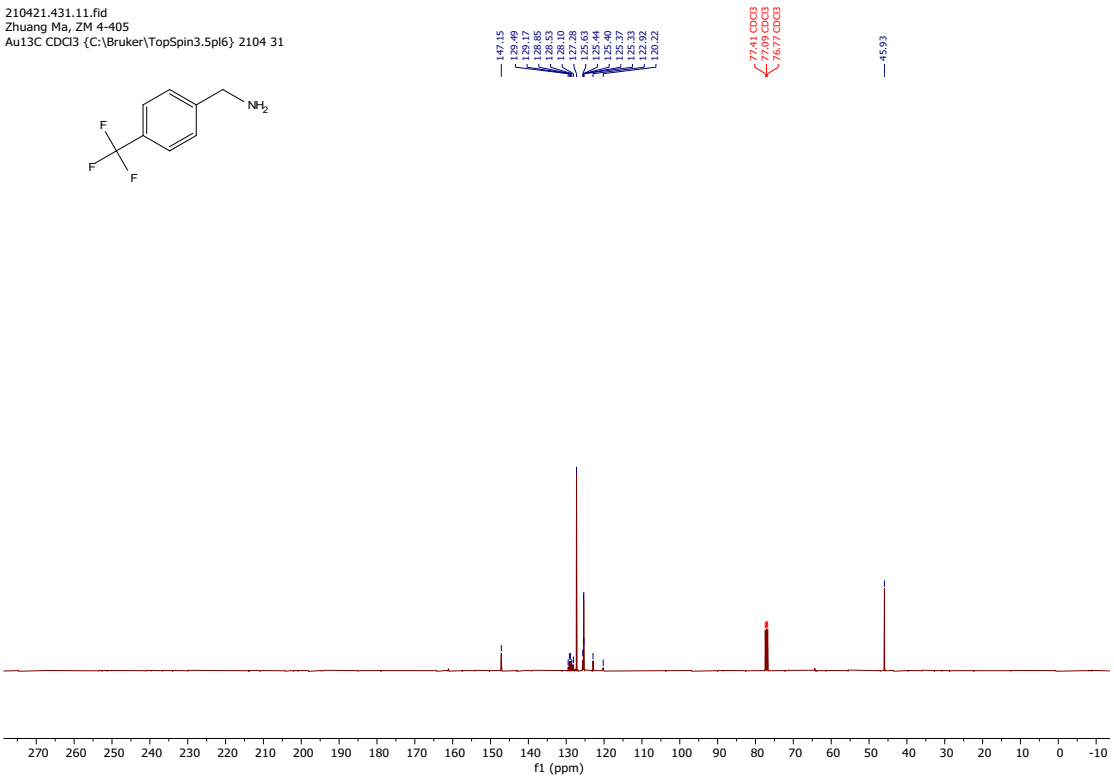
210427.446.11.fid
Zhuang Ma ZM4-413
Au13C DMSO {C:\Bruker\TopSpin3.5pl6} 2104 46



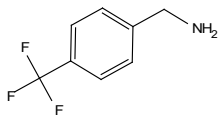
210421.431.10.fid
Zhuang Ma, ZM 4-405
Au1H CDCl3 {C:\Bruker\TopSpin3.5pl6} 2104 31

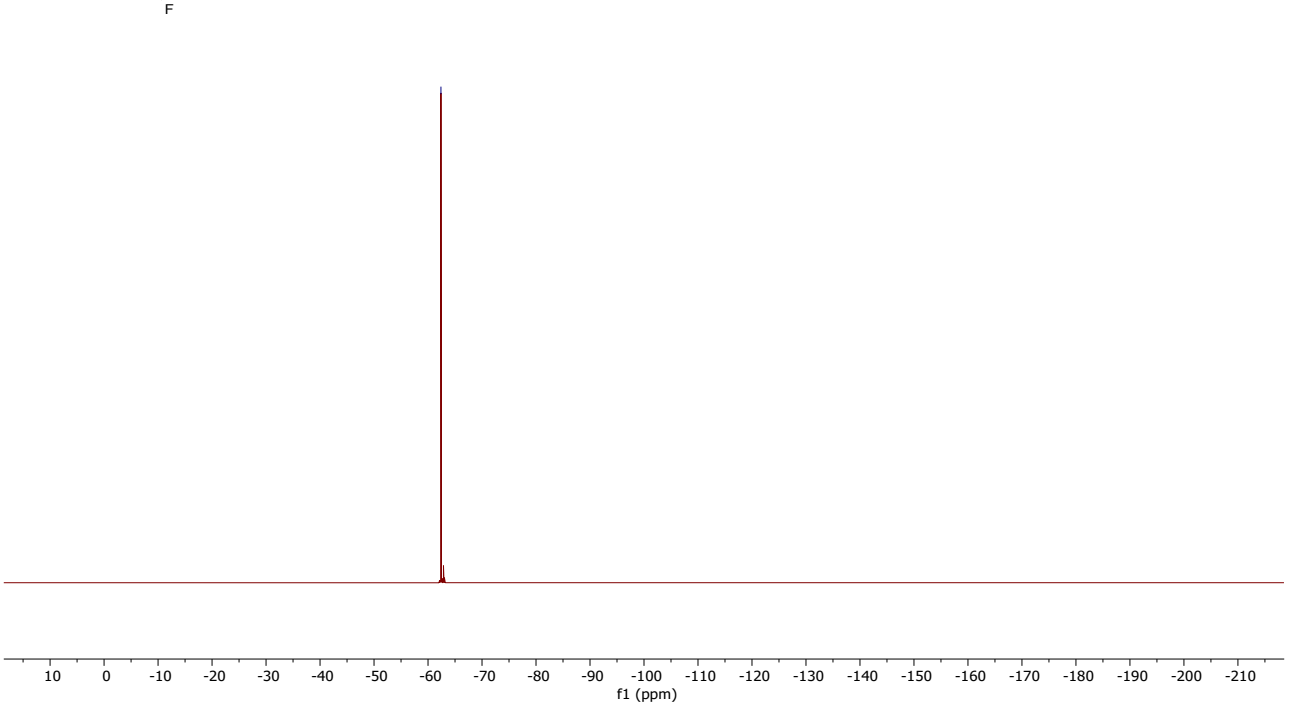


210421.431.11.fid
Zhuang Ma, ZM 4-405
Au13C CDCl3 {C:\Bruker\TopSpin3.5pl6} 2104 31

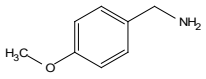


210423.445.10.fid
Zhuang Ma ZM4-405
F19 CDCl3 {C:\Bruker\TopSpin3.5pl6} 2104 45

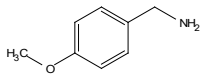




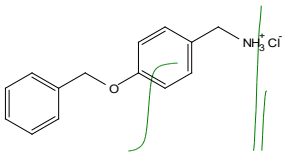
210421.434.10.fid
Zhuang Ma, ZM 4-412
Au1H CDCl3 {C:\Bruker\TopSpin3.5pl6} 2104 34



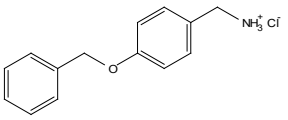
210421.434.11.fid
Zhuang Ma, ZM 4-412
Au13C CDCl3 {C:\Bruker\TopSpin3.5pl6} 2104 34

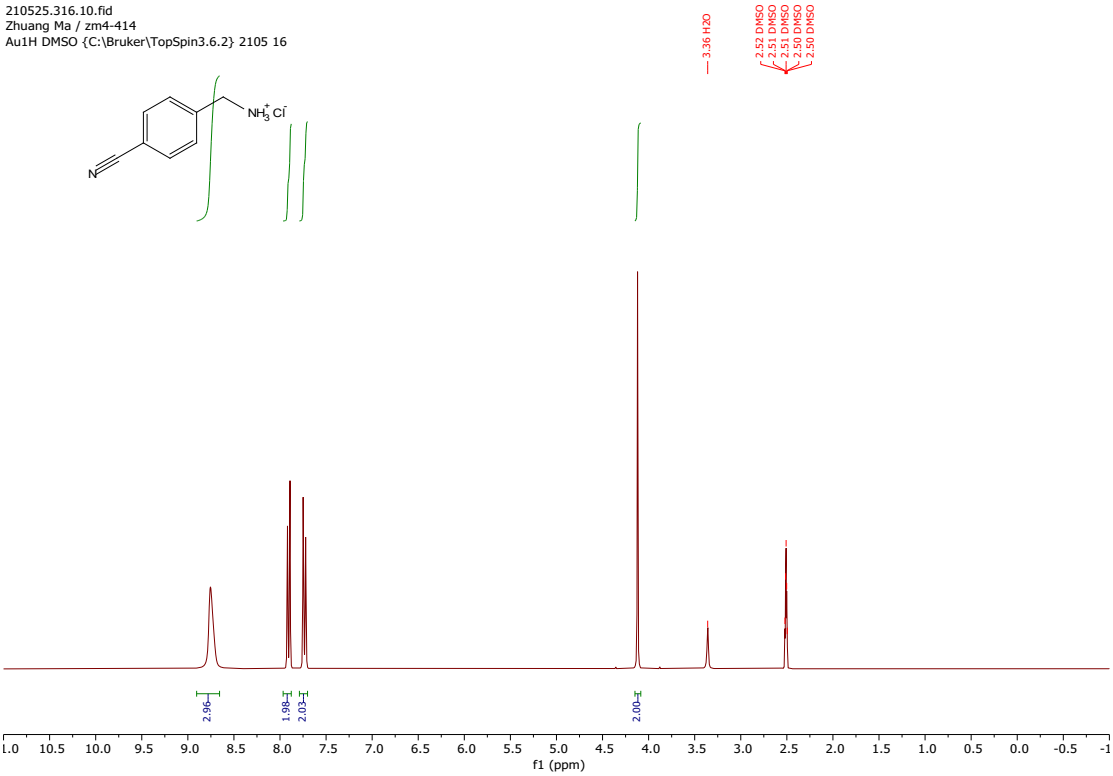


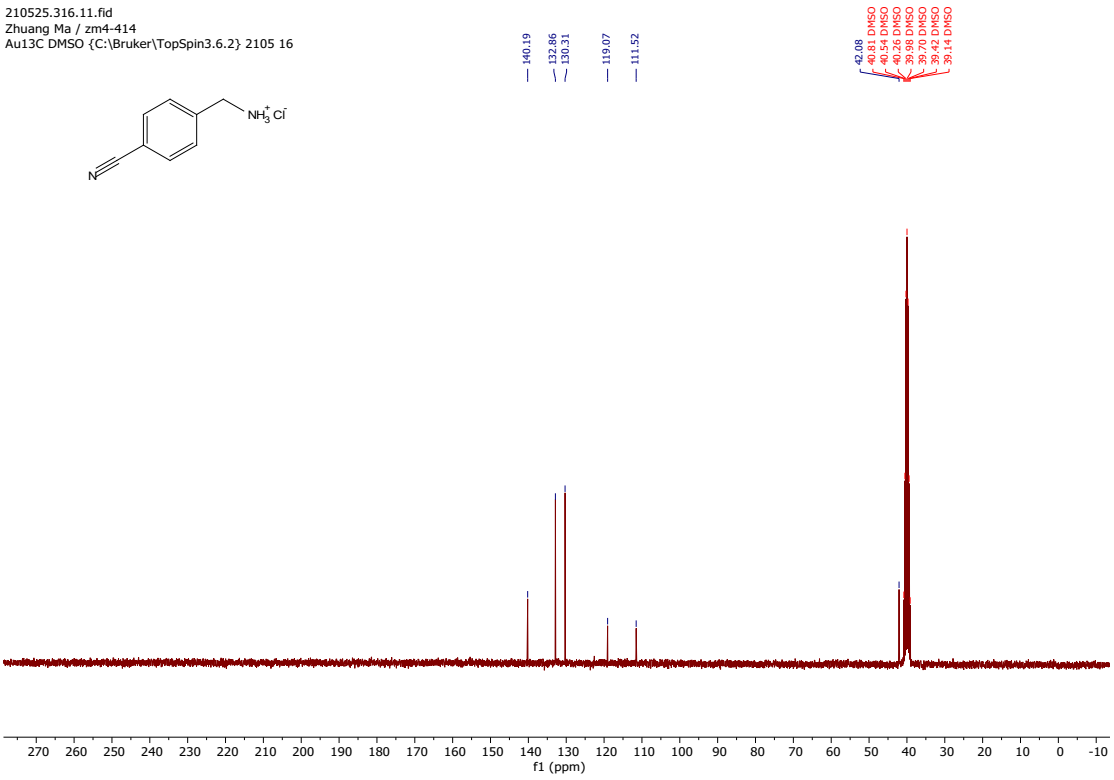
210427.452.10.fid
Zhuang Ma ZM4-408
Au1H DMSO {C:\Bruker\TopSpin3.5pl6} 2104 52

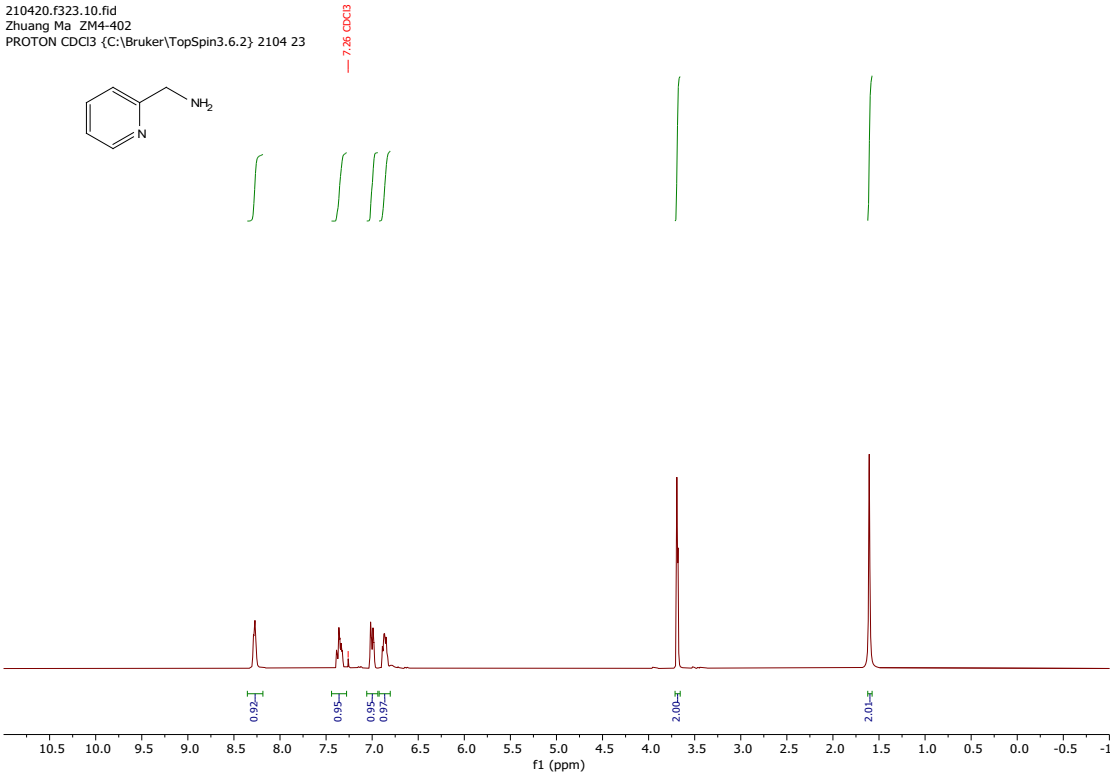


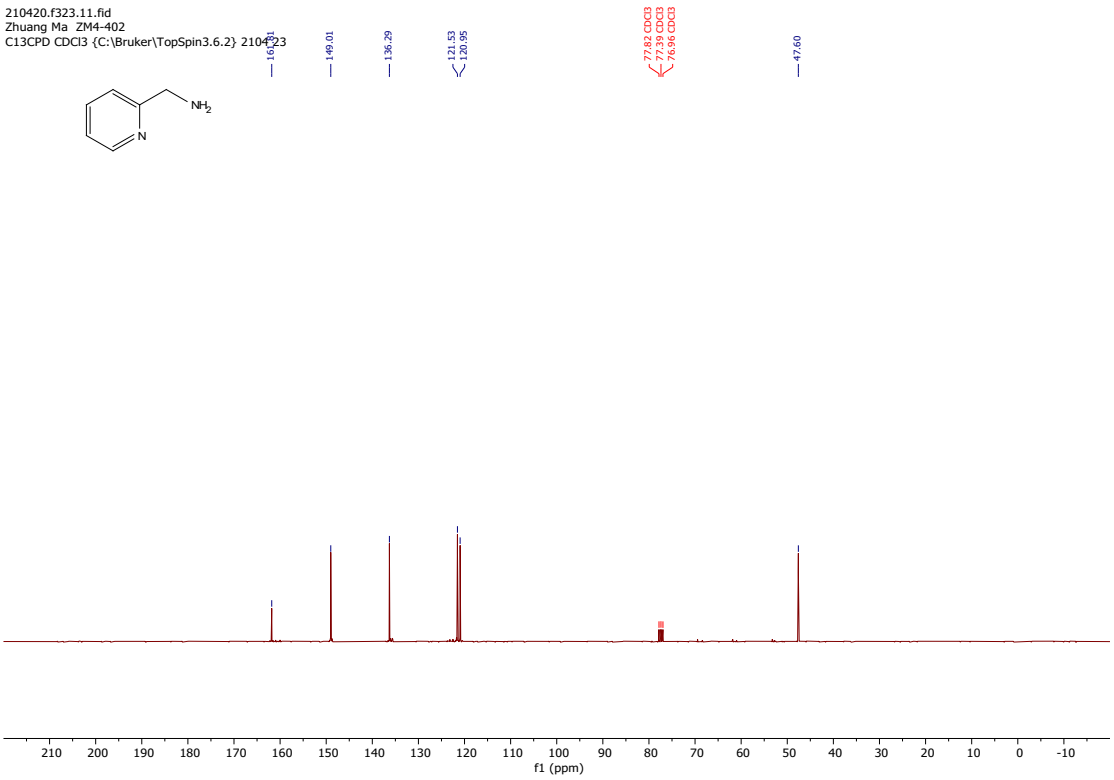
210427.452.11.fid
Zhuang Ma ZM4-408
Au13C DMSO {C:\Bruker\TopSpin3.5pl6} 2104 52



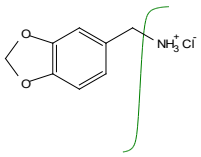

210525.316.10.fid
Zhuang Ma / zm4-414
Au1H DMSO {C:\Bruker\TopSpin3.6.2} 2105 16
3.36 H2O
2.52 DMSO
2.51 DMSO
2.51 DMSO
2.50 DMSO
2.50 DMSO
NH3+ Cl-
N
2.96
1.98
2.03
2.00
f1 (ppm)

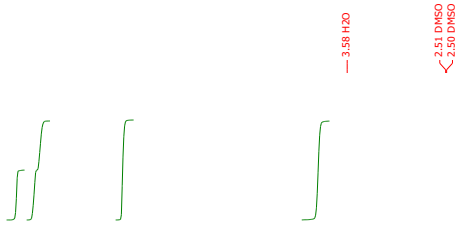

210525.316.11.fid
Zhuang Ma / zm4-414
Au13C DMSO {C:\Bruker\TopSpin3.6.2} 2105 16
140.19
132.86
130.31
119.07
111.52
42.08
40.81 DMSO
40.54 DMSO
40.26 DMSO
39.98 DMSO
39.70 DMSO
39.42 DMSO
39.14 DMSO
NH3+ Cl-
N
f1 (ppm)

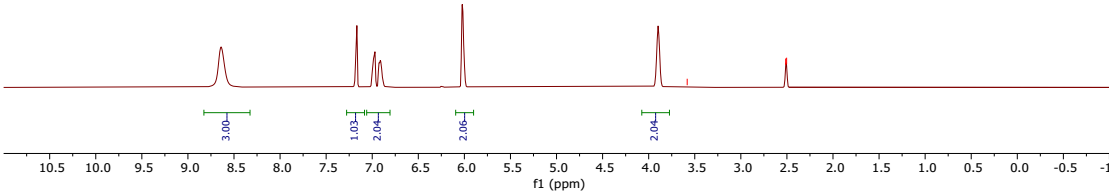

210420.f323.10.fid
Zhuang Ma ZM4-402
PROTON CDCl3 {C:\Bruker\TopSpin3.6.2} 2104 23
7.26 CDCl3
NH2
N
0.92
0.95
0.95
0.97
2.00
2.01
f1 (ppm)


210420.f323.11.fid
Zhuang Ma ZM4-402
C13CPD CDCl3 {C:\Bruker\TopSpin3.6.2} 210423
160.31
149.01
136.29
121.53
120.95
77.82 CDCl3
77.39 CDCl3
76.95 CDCl3
47.60
NH2
N
f1 (ppm)

210427.455.11.fid
Zhuang Ma ZM4-403
Au1H DMSO {C:\Bruker\TopSpin3.5pl6} 2104 50







210427.455.11.fid
Zhuang Ma ZM4-403
Au13C DMSO {C:\Bruker\TopSpin3.5pl6} 2104 50